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Franco-British responses to chemical warfare 1915–8, with special reference to the medical services, casualty statistics and the threat to civilians

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Abstract

This dual-focussed examination will critically compare and contrast the British Royal Army Medical Corps and the French Medical Service's involvement in the Western Front chemical campaign between 1915 and 1918. Because the Anglophone historiography has tended to marginalise the French contribution to the allied chemical war, this article will attempt to re-balance the historical narrative by emphasising the collective nature and importance of this joint Franco-British enterprise. By interrogating a raft of under-utilised primary evidence in the French and British archives, this investigation will contribute to the 'alliance literature' by arguing that when it comes to aspects of the Franco-British chemical war such as the co-operation of the medical services, the appellation 'together but alone' does not fully hold. The article will explore avenues of the two national armies evolving process of mutual medical assistance, material exchange and scientific collaboration. The striking similarity of French and British gas casualty statistics is highlighted with reference to the overall congruence of their anti-gas strategies – notwithstanding the problematic nature of these statistics. In addition to enhancing soldiers' resistance to the poison gas threat on the battlefield, the Medical Services were also responsible for the protection of local civilians in the war zones. With reference mainly to France, this investigation will discuss the significance and implications of the poison gas threat to the home front. Finally, the impact of chemical weapon production upon civilian war workers in France and Britain will be commented upon.

Keywords: Gas; War; Medical; Civilians; Masks; Casualties

Introduction

The great gas war – for such an epithet perhaps fittingly describes much of the Western Front campaign – began on the afternoon of 22 April 1915 when a large volume of compressed chlorine was released from thousands of storage cylinders in the German trenches along the northern arc of the Ypres Salient. Dense clouds of the asphyxiating gas drifted with the wind into a 4-mile-wide sector held by units of the French forty-fifth (Algerian) and eighty-seventh (Territorial) divisions, killing some soldiers outright, seriously incapacitating many more and causing rapid withdrawal of the others in much of the affected area.¹

¹Unless otherwise stated, all foreign languages' translation into English are the author's. For a detailed account of the first German gas attack, see *Service Historique de la Défense Vincennes* (hereafter abbreviated SHD), 16N826, report No. 3711, from Dr Sieur Chief of Health Service of the Belgian Army to the General Director of Health Service and the Commander-in-Chief (hereafter abbreviated C-in-C), 25 April 1915. French and British monographs have covered in detail the Second Battle of Ypres. For example, see Tim Cook, *No Place to Run: The Canadian Corps and Gas Warfare in the First World War* (Vancouver, BC: University of British Columbia Press, 1999), 21–2. For a first-hand account, see General Mordacq, *Le Drame de L'Ysère* (Paris: Imp du Petit Journal, 1933), 62–8.

Despite being almost wholly unprepared for conducting such a form of warfare, France and Britain nevertheless responded in kind within 6 months of the first German attack.²

The purpose of this article is to investigate aspects of the short- and longer-term French and British military reactions to the German chemical warfare initiative with special reference to the contribution of the two allied medical services. The largely under-researched area of the gas threat to civilians will also be scrutinised. Information about the French military response is based on a raft of hitherto unexplored or under-exploited primary sources – especially detailed reports, memos, letters, statistical digests, tables and maps – originating from the French first, second and third bureaus and now housed in the *Service Historique de la Défense* (National Military Archives in Vincennes). The equivalent British primary sources have been opened to researchers since the 1960s and have resulted in some major monographic and other contributions to the literature. Collectively, this French and British material demonstrates how incomplete our understanding of the great gas war has been due to an over-reliance on a corpus of literature, which has almost exclusively focused on British, Commonwealth (especially Canadian and Australian) and American experience, creating what amounts to a serious imbalance in the historiography. This paper will endeavour to offer a corrective to this largely Anglo-centric narrative. Through a selective comparative examination of the development of French and British medical services, a more comprehensive and balanced overview of the allied gas war will be attempted. In addition, a number of important related issues, such as the problematic nature of gas warfare casualty statistics and the implications arising from the threat of poison gas to civilians in France and Britain, will also be discussed.

Franco-British Medical Services and the gas war

The use of poison gas in the First World War ignited a searching and, at times, heated debate, which continues to this day. The historiography of the great gas war comprehensively mirrors this diversity of opinion. There has been very little comparative examination of the work of the French and British medical services in the literature of the great gas war.³ Even recent studies have eschewed comparative perspectives. For example, neither Marc Scherschel's 2002 thesis nor Alain Combarieu's *La Guerre des Gaz 1915–1918* even acknowledges the significant role of the Royal Army Medical Corps⁴ on the Western Front;⁵ while Marion Girard's 2008 monograph – which addresses medical issues in one of the chapters – is confined wholly to the British experience.⁶ The most recent addition to the gas war historiography is *One Hundred Years of Chemical Warfare* published in 2017 to commemorate the centenary of the Great War.⁷ This volume made path-breaking contributions to our understanding of the importance of the origins and consequences of the gas warfare, as well as its subsequent history during World War II and beyond. However, the highly focused angle of Franco-British Medical Services' responses to chemical weapons was perhaps unavoidably not tackled. The only major critical work that crosses national boundaries on the subject is Haber's earlier but widely acclaimed *The Poisonous Cloud*.⁸

²The first French and British retaliation occurred on 25 September 1915.

³Gerard J. Fitzgerald, 'Chemical Warfare and Medical Response During World War I', *American Journal of Public Health*, 98, 4 (2008), 611–25; and Fiona Reid, '“Playing the Game to the Army:” The Royal Army Medical Corps, Shell Shock and the Great War', *War and Society*, 23, 1 (2005), 61–86.

⁴Hereafter abbreviated RAMC.

⁵Marc Scherschel, 'Le Combattant Gazé de la Grande Guerre Emploi des Gaz, Prise en Charge et Traitement des Gazés par le Service de Santé au Cours du Conflit: Réforme Pension et Soins des Anciens Combattants' (unpublished PhD thesis: University of Nancy, 2002), 233–242; Alain Combarieu, 'La Guerre des Gaz 1915–1918 Mise en Perspective Historique du Témoignage du Docteur Paul Voivnel' (unpublished PhD thesis: University of Paul Sabatier, 2002), 174; and Fabien Bunlon, 'Les Médicaments Issus des Gaz de Combat de la Première Guerre Mondiale' (unpublished PhD thesis: Reims University, 2009), 216–241.

⁶Marion Girard, *A Strange and Formidable, Weapon British Responses to World War I Poison Gas* (Lincoln: University of Nebraska Press, 2008), 76–101.

⁷Bretislav Friedrich *et al.* (eds), *One hundred Years of Chemical Warfare: Research, Deployment, Consequences* (New York: Springer, 2017), 189 and 159.

⁸L.F. Haber, *The Poisonous Cloud Chemical Warfare in the First World War* (Oxford: Clarendon Press, 1986), 41 and 239.

While in general Haber dismissed the French record on anti-gas defence as ‘undistinguished’, he nevertheless recognised their *centres medico-légaux* – the mobile forensic laboratories – as ‘invaluable’ and which were worthily copied by other allied armies.⁹ But the German historian’s claim that the performance of the French army’s medical service¹⁰ was inferior to the RAMC appears insufficiently supported by corroborating evidence. This is perhaps unfortunate because Haber is the only accessible authority on the French Medical Service which is available in the English language. While a detailed and comprehensive examination of the two allies’ medical services in the gas war cannot, for reasons of space, be accommodated within the present investigation, the following selective discussion will nevertheless draw particular attention to contrasts in their organisational responsibilities and approaches to the management of gas casualties.

As a response to the unprecedented nature and scale of the conflict, the French and British medical services expanded exponentially between 1914 and 1918. There were 16 000 physicians in the FMS by 1918, while the RAMC comprised 13 000 officers and 154 000 other ranks in the final year of the war.¹¹ After April 1915, the enemy’s use of poison gas made increasing demands upon the allied medical services, not least by the challenges to diagnosis and therapy posed by the dynamic nature of the chemical war, which saw the eventual introduction of at least eighteen toxic gasses by the German army.¹² While France and Britain spent much of the gas war responding to enemy initiatives, they did not have to react in isolation.¹³ As the authors of the official British history of the First World War which dealt with the medical services emphasised, there was close co-operation between the two allies’ gas services especially from 1916 onwards.¹⁴ This included the sharing of medical knowledge and expertise. Officers from the British Medical Service attended inter-allied gas conferences in Paris, and there was a full exchange of technical reports and other medical literature while representatives of the FMS and the RAMC had the advantage of comparing each other’s organisational details and latest treatment methods.¹⁵

Perhaps the major organisational difference between the FMS and the RAMC concerned their scope of responsibility. The FMS had a far wider anti-gas brief than their British counterpart. Their tasks included the development of protective equipment and research into lethal gas. They co-operated closely with the Military Health Service (a department within the War Ministry) in the organisation of conferences to update health personnel with the latest research, and they played an important part in educating the training personnel who disseminated the principles of anti-gas discipline.¹⁶ The training duties of the Medical Service were not rigidly restricted to educational centres. For example, in the summer of 1915, Dr Dopter, a major attached to the French army on the Western Front who managed a

⁹*Ibid.*, 110.

¹⁰Hereafter abbreviated FMS.

¹¹Stéphane Audoin-Rouzeau, ‘George Duhamel, Médecin Ecrivain de Guerre, Les Cahiers de L’Abbaye de Créteil’, *Historial de la Grande Guerre*, November 1994, 27–38. For British figures, see, for example, Richard A. Gabriel and Karen S. Metz, *A History of Military Medicine*, vol. 2 (New York: Greenwood Press, 1992), 247.

¹²John Haller, ‘Gas Warfare: Military Medical Responsiveness of the Allies in the Great War, 1914–1918’, *New York State Journal of Medicine*, 90 (1990), 502–4. See Wellcome Archives, RAMC 444/13, memorandum containing severe criticisms of the Medical Services by Sir Alfred Fripp, Sir Alexander Ogston, Sir Cooper Perry and Dr T.J. Horder; Wellcome Archives, RAMC 446/11, ‘The Medical Services of Our Army, Urgent Reforms Observations’, presented by Dr Doyen on 7 July 1915 to the Commission of l’Armée du Sénat (Service de Santé) to the Commission d’Hygiène de la Chambre des Députés; Wellcome Archives, PP/CLE/A.3, Lovatt Evans: ‘Lectures on Gas Defence’ – Millbank Correspondence 1916; and Wellcome Archives, PP/CLE/A.4, Lovatt Evans: Miscellaneous Notes for Lectures on Anti-Gas Measures/Photograph Album Menu 1916–1918.

¹³Wellcome Archives, RAMC/588, Colonel R.J. Blackham, Pamphlet of the French Medical Service in the Field, [?] September 1916.

¹⁴W.G. Macpherson *et al.*, *History of the Great War Based on Official Documents, Medical Services Diseases of War*, vol. 2 (London: His Majesty’s Stationery Office, 1923), 420–441. The work of the French Official Medical Services in the Great War was compiled by Alfred Mignon, *Le Service de Santé Pendant la Guerre* (Paris: Masson, 1926), 664–674.

¹⁵Macpherson *et al.*, *op. cit.* (note 14), 249.

¹⁶SHD, 7N1984, memo from the Military Health Service to the Heads of the Regions’ Health Services and the General Commanders of the Armies, 1 May 1916. Eight pharmacists from each region were sent to the Pharmaceutical Institute in Paris.

field laboratory, visited the Third and Fourth armies in the field to teach efficient anti-gas procedures.¹⁷ The importance of offering practical advice to front line soldiers in an informal setting was emphasised by General Pellé, Chief of Staff at General Headquarters on 22 August 1915:

In each regiment we will gather in the areas where soldiers have their breaks, groups of officers of all grades, junior officers and soldiers. The necessary instructions will then be given to each group. Medical officers will explain briefly all the methods of assuring complete [anti-gas] protection with the equipment available.¹⁸

The FMS created a new department that autumn to research the psycho-pathological effects of asphyxiating substances on soldiers, an indication of official concern about the psychological as well as the physical well-being of gas victims, while the clinical investigation of gas casualties was widened. A memo sent in early October 1915 to the C-in-C suggested that all soldiers who had experienced contact with enemy toxic or asphyxiating agents should be subjected to haematological and urological examination.¹⁹

In his study of the French gas war, Lepick argues that, because of the unfamiliar nature of the pathological effects of the new chemical weapon, it was not until the spring of 1916 that more successful therapies were available for gas casualties. While Lepick emphasises the more improvised nature of the treatment methods available in 1915, the archival evidence suggests that even by October of that year the FMS were consolidating strategies to deal with poison gas battlefield casualties.²⁰

To begin with, French army relief posts and ambulances were equipped with oxygen bottles. This practise had been adopted by the German army in September 1915 and was soon emulated by the French (and British).²¹ Extra protection for stretcher-bearer teams was ensured by the provision of oxylythe respirators.²² A standard approach was adopted in the handling of gas victims. To minimise the danger of provoking cardiac collapse, casualties were encouraged to be passive and even to avoid speaking. Morphine was to be used where necessary, while the injection of oxygen through the skin became a common practise for certain categories of gas victim, especially those with suspected cyanosis.²³ The importance of the rapid evacuation of gas casualties was understood, and even though Lepick stresses that until the end of 1915 gassed soldiers were not separated from other wounded combatants, the French army's report following the German gas attacks of 20–2 October 1915 appears to imply that such separation did, in fact, take place.²⁴ Once hospitalised, gas victims were to be kept in rooms with a slightly humid atmosphere and a constant temperature.²⁵ But it remains unclear, however, what the impact of such measures was upon the seriously gassed cases. As Macpherson, Herringham *et al.* concluded, while the use of oxygen and venesection possibly saved the lives of a small fraction of gas casualties who might

¹⁷SHD, 16N832, report No. 2664/S, from Dr Dopfer to the C-in-C, 27 August 1915.

¹⁸SHD, 16N826, report No. 2324/S, from Pelle to General Foch, Dubail, de Castelnaud and to the Head of the Medical Service, 'The Organisation and the Instruction Regarding Asphyxiating Gas', 22 August 1915. Special ambulances would be available in reserve. Repair workshops were built to maintain and repair anti-gas protective equipment.

¹⁹SHD, 16N832, report No. 2163, from the Under-Secretary of State to the C-in-C, 2 October 1915. The Under-Secretary of State wrote: 'I would like to draw your attention that in addition to the department supervised by Kling which is in charge of research on the nature of toxic agents used by the enemy, there should be another department in charge of research on psychico-pathological effects upon gassed soldiers'.

²⁰Olivier Lepick, *La Grande Guerre Chimique 1914–1918* (Paris: Presses Universitaires de France, 1998), 279.

²¹Macpherson *et al.*, *op. cit.* (note 14), 420–41; and Lepick, *ibid.*, 280.

²²See also SHD, 16N833, memo from the Head of the Medical Service, 19 October 1915 from 9pm to midnight the 38th Corps evacuated 1 259 victims and on 20 October 1915 from 6pm to the following day 1 500 and on 22 October 1915 in the evening 3 649 were evacuated. The relief posts and ambulances were well equipped with oxygen bottles, [?] November 1915.

²³SHD, 16N833, letter No. 421, from the Health Service attached to the 38th Army Corps to the third bureau, [?.1915]; SHD, 16N827, letter No. 96, from Centre Medico-Legal of Amiens to the C-in-C, 21 February 1916; and SHD, 16N833, memo, from Centre Medico-Legal to the C-in-C, 18 October 1918.

²⁴Lepick, *op. cit.* (note 20), 281–2.

²⁵SHD, 16N833, *op. cit.* (note 23).

otherwise have died, the major challenge to the allied medical services was restoring to fitness the majority of the nonlife threatened victims in the shortest possible time.²⁶

As the number of gas casualties escalated in 1917, the FMS developed – later that year – a system of dedicated injury centres, which only received poison gas cases. The systematic process of separating gas casualties from those wounded by conventional weapons was initiated the following July when a more elaborate version of this specialised organisation, known as the ‘Z’ system, came into being.²⁷ The importance of the French army’s creation of such a focused organisation to handle and treat gas casualties was acknowledged by the official British war historians in 1923.²⁸ As it happened, the British army trailed their French allies when it came to more specialised gas casualty separation even though the French had kept their ally up to date with their latest initiatives.²⁹ The British system overseen by the RAMC involved handling all casualties via a chain of medical units extending from the regimental first-aid posts through field ambulances and casualty clearing stations to the base hospitals. In theory, every link in the chain was supposed to be capable of treating every type of disease or wound including injury by poison gas.

For geographical and logistical reasons, however, the implications arising from inefficient or inconsistent gas casualty separation practise became a more pronounced headache for the British army. The problem was referred to – perhaps somewhat callously – as ‘wastage’, that is those mildly gassed soldiers who could have been treated in France and returned to active service instead of being sent home for extended convalescence.³⁰ In 1915, nearly all gassed casualties were returned to Britain, but with the huge increase in gas casualties in the latter part of the war, the estimated ‘wastage’ in 1917–8 exceeded 35 000, which was the equivalent of two army divisions.³¹ What the British military authorities discovered was that when gassed troops had been segregated at base hospitals for careful medical scrutiny, ‘wastage’ was dramatically reduced. There is less indication in the French archives that ‘wastage’ was such a pressing problem in the French army. Even so, by late 1918 with escalating numbers of gas casualties, there was official concern that French hospital trains were transporting lightly gassed casualties to distant recovery locations, which then delayed their return to duty.³² But at least the French were spared the complication of having to transport their gas casualties across the English Channel.

The complexity of treatment required to address mustard gas injuries prompted new organisational and therapeutic strategies.³³ The French decided that the separation of their *ypérités* was to be avoided.³⁴ From July 1917 onwards, they were to be collectively evacuated either to Paris or to Lyon. A common programme of specific treatment procedures was implemented following a soldier’s exposure to mustard gas until his admission to hospital.³⁵ Following triage, the lightly gassed were kept for days to rest in the

²⁶Macpherson *et al.*, *op. cit.* (note 14), 247 and 506–8.

²⁷Macpherson *et al.*, *op. cit.* (note 14), 502–3.

²⁸Macpherson *et al.*, *op. cit.* (note 14), 248–9 and 502–3.

²⁹*Ibid.*

³⁰Macpherson *et al.*, *op. cit.* (note 14), 515.

³¹*Ibid.* See also K. Caffrey, *Farewell Leicester Square* (London: André Deutsch, 1980), 11, for details of average British army divisional sizes.

³²SHD, 16N838, report No. 15, from the President of Ministry Council for War to the C-in-C, 18 September 1918.

³³Edgar Jones, ‘Terror Weapon: The British Experience of Gas and Its Treatment in the First World War’, *War in History*, 21, 3 (2014), 355–75; and Jürgen Renn, ‘Introduction’, in Bretislav Friedrich *et al.* (note 7), 4.

³⁴Under-Secretary of State of the Military Health Service, *Notice Clinique et Thérapeutique de l’Intoxication par les Gaz* (Paris: Imprimerie Typographique, 1918), 3–5; and F. Dorandeu *et al.*, ‘Ypérite: La Levée de Rideau’, *Médecine et Armée*, 45, 1 (2017), 51–9. In France, servicemen had to follow particular health procedures from the very moment they were gassed till their admission to the hospitals. The initial and urgent practices were washing with water and soap, and change of uniforms and oxygen therapy had to be carried out at the regimental and divisionary aid posts. Similarly, British soldiers exposed to mustard gas, especially in high concentrations or for long periods of time, needed to bath with soap and water like their French counterparts. Mustard gas victims had their eyes promptly washed in order to reduce the duration of severe conjunctivitis, which lasted few weeks.

³⁵Paris had between 7 000 and 8 000 beds in twelve services. See J.J. Ferrandis, ‘La Prise en Charge Médicales des Gazés au Front et à l’Hôpital – les Ambulances Z’, *Médecine et Armée*, 45, 1 (2017), 77–80.

two depots. The ‘grands’ or severely gassed were transported in the dedicated ‘Z’ ambulances where specialised respiratory and ophthalmic treatment was dispensed.³⁶ According to official French evidence, the collective and cumulative impact of organisational and medical improvements in the management of French gas casualties was responsible for the decrease in gas casualty rate from 6% in 1917 to 2% in the summer of 1918.³⁷ According to British evidence, the recuperation time from mustard gas exposure – 46 days – was similar to that of phosgene.³⁸ Even so, in both Britain and France, servicemen’s treatment and care remained highly challenging during the final year of the war as a consequence of an increase in the frequency of gas attacks on the Western Front.³⁹

The RAMC differed from their French counterparts in so far as they worked within a professional and institutional orthodoxy, which was both defined and limited by the conventional medical imperatives of diagnosis and prescription.⁴⁰ In the context of the chemical war, this meant the identification of poison gases afflicting battlefield victims and their treatment.⁴¹ The regular updating of medical field handbooks by expert civilian authorities enabled RAMC medical officers on the battlefield to apply best-practise therapy to gas victims, although this informational process has been the subject of recent criticism.⁴²

While a considerable number of books have appeared on the achievements of the RAMC during the last 90 years, very little of this work is either critical or relevant to the corps’ activities during the gas war.⁴³ An exception is the relevant two-volume official British World War I history, which, despite being uneven and selective in its treatment, is an essential starting point for any re-evaluation of the RAMC, although the latter (1931) volume by Mitchell and Smith on British wartime medical statistics is disappointingly limited on the issue of gas casualties.⁴⁴

A chapter in Marion Girard’s study provided a long-awaited opportunity to reappraise this subject.⁴⁵ Girard’s largely negative assessment of the RAMC’s performance in the gas war is addressed within a critical dichotomy that contrasts the professional opportunities, achievements and enhanced status realised by scientists – especially chemists and research physicians – with what she implies was the ineffectiveness of the RAMC and the associated negative status suffered by its medical officers.⁴⁶ Girard maintains that, unlike the scientists, the military physicians were always playing ‘catch-up’. Moreover,

³⁶By the armistice, the French army had more than one hundred ‘Z ambulances’. *Ibid.*, 58.

³⁷J. Ferrandis and Alain Larcen, *Le Service de Santé aux Armées Pendant la Première Guerre Mondiale* (Paris: Edition LBM, 2008), 45.

³⁸Fitzgerald, *op. cit.* (note 3), 618.

³⁹Ulf Schmidt, ‘Preparing for Poison Warfare: The Ethics and Politics of Britain’s Chemical Weapons Program, 1915–1945’, in Friedrich *et al.*, *op. cit.* (note 7), 85; and C.L. Hermitte, *Les Effets de l’Ypérite: Etude de Cas à Partir d’Archives de la Première Guerre Mondiale* (Paris: Université Pierre et Marie Curie, 2011), 32–9.

⁴⁰For a period early in the gas war, the RAMC had been responsible (like the FMS) for the provision of defensive measures against gas as well.

⁴¹Wellcome Archives, RAMC 739/11/4, Henry Waynard Kaye, ‘Notes and Observations on 321 Cases of Asphyxia Caused by an Enemy Gas Attacks’, 30 April 1916; Wellcome Archives, RAMC 739/7, ‘Diary: October 17, 1915 to August 23, 1916’, A.T. Sloggett, *Memorandum on the Treatment of Injuries in War Based on the Experience of the Current Campaign* (London: HMSO, 1915), 101–120; A.T. Sloggett, *Memorandum on Gas Poisoning in Warfare with Notes on Its Pathology and Treatment* (London: Avenue Press, 1916), 11–22; A.T. Sloggett, *Memorandum on Gas Poisoning in Warfare with Notes on Its Pathology and Treatment* (London: Avenue Press, 1918), 8–13 and 20–8; Wellcome Archives, EPH1:11, C.F.N. Mac Ready, ‘Defensive Measures Against Gas Attacks’; Wellcome Archives, PP/CLE/A.3, ‘Files and Lectures on Gas Defence’, Millbank Correspondence 1917 Starling I/C; and Wellcome Archives, RAMC/793/23/23/5, ‘Printed Instructions re. Defensive Measures Against Gas Attacks, Use of Respirators and Smoke Helmets’ <https://wellcomecollection.org/works/qv7hcdvg>.

⁴²Girard, *op. cit.* (note 6), 91–2.

⁴³F.S. Brereton, *The Great War and the R.A.M.C.* (London: Constable and Company, 1919), 1–11; Redmond McLaughlin, *The Royal Army Medical Corps* (London: Leo Cooper, 1972), 33–60; John Blair, *In Arduis Fidelis, Centenary History of the Royal Army Medical Corps* (Edinburgh: Scottish Academic Press, 1998), 126–64; and A.E.W. Miles, *The Accidental Birth of Military Medicine, The Origins of the Royal Army Medical Corps* (London: Civic Books, 2009), 173–7.

⁴⁴Thomas Mitchell and G.M. Smith, *Medical Services: Casualties and Medical Statistics of the Great War* (London: HMSO, 1931), 112.

⁴⁵Girard, *op. cit.* (note 6).

⁴⁶Girard, *op. cit.* (note 6), 76–7.

she argues that the RAMC ‘failed to master’ gas injuries, although she does not explain in detailed practical terms what this means. It could be argued, of course, that *everyone* on the allied side (Girard does not include the French in her examination, unfortunately) who was professionally involved in the gas war was playing ‘catch-up’ including the research scientists who were continually having their knowledge and expertise searchingly tested by Germany’s latest initiatives. The dynamic nature of the chemical war with the frequent introduction of new poison gases made ‘mastering’ the treatment of injuries particularly challenging, but the pattern of gas casualty statistics between 1915 and 1918 (which Girard acknowledges) sits awkwardly with her claim about the impact of the RAMC. Neither Girard, nor anyone else, has demonstrated what measurable contribution the medical service made, for example, to the remarkable decline in the British army’s gas casualty mortality rates between 1915 and 1918, but the fact that the French army’s rates were roughly similar may suggest that a broader cross-national empirical approach is required on this and some of the other aspects of the area that she discusses.

Gas casualties

France

In an effort to gauge empirically the effectiveness of the FMS and the impact of anti-gas discipline on soldiers, an interrogation of the official gas casualty statistics would appear to be both logical and necessary. However, it is important to stress that much of that statistical evidence is problematic. It is necessary to briefly explain why and to explore some of the implications.

While the French authorities had grappled with the challenge of gathering, collating and updating detailed casualty statistics as a whole in the earlier stages of the Great War – there was a ministerial decree enacted on the subject in January 1916⁴⁷ – the recording of reliable gas casualty figures appears to have remained an outstanding problem.⁴⁸ A near contemporary explanation of the situation can be found in a report written by Dr Joseph Toubert, a medical officer in the French army. Toubert noted that comprehensive French gas casualty statistics were only recorded from as late as January 1918.⁴⁹ It was a state of affairs that had irritated senior army commanders. According to Lepick, Joffre had asked ‘time and time again’ for detailed and accurate gas casualty figures to be made available,⁵⁰ but before January 1918, such information as was available was dissipated in the administrative archives, the medical service and the fifth bureau.⁵¹ French army documents confirm that pre-1918 French gas casualty statistics were, in fact, estimates.⁵² By contrast, the 1918 material is not only more reliable, but as will be explained below, much more detailed and revealing. The French were not, of course, alone or even the worst offenders in leaving behind problematic gas casualty statistical evidence, but a wider discussion of that problem belongs elsewhere.

Given the rather loose foundations of the official French gas casualty statistics (at least for much of the conflict), it is perhaps inevitable that latter authorities have disputed the precise numbers, often by wide margins. For example, Lepick’s (1998) total gas casualty figure of 130 000 is no less than 52 000 lower

⁴⁷SHD, 6N2, report from the third bureau to the C-in-C, 25 February 1916.

⁴⁸A global picture of French statistics about gas victims could be pieced together based on various sources such as Ministère de la Guerre, Direction du Service de Santé, Etude Statistique, Chirurgicale, Guerre, 1914–1918, *Les Blessés Hospitalisés à L’Intérieur du Territoire, l’Evolution de leurs Blessures*, vol. 2 (Paris: Imprimerie Nationale, 1924), 363–72; Alfred Mignon, *Le Service de Santé Pendant la Guerre, 1914–1918* (Paris: Masson, 1926), 664 and 672–4; and Joseph Toubert, *Le Service de Santé Militaire au Grand Quartier Général Français Le Langage des Chiffres et des Graphiques* (Paris: Charles Lavauzelle, 1923), 29–30 and 154. See also Joseph Toubert’s conference paper ‘Etude Statistique des Pertes Subies par les Français Pendant la Guerre de 1914–18’, presented at Hôpital Val-de-Grâce in July 1920.

⁴⁹Toubert, *ibid.*, 95.

⁵⁰Lepick, *op. cit.* (note 20), 314–5, where he quotes Haber’s ‘Gas Casualties’ chapter in Haber, *op. cit.* (note 8).

⁵¹The fifth bureau within the War Ministry was where all the administrative and archival documents were filed.

⁵²SHD, 6N2, report from the first bureau to the C-in-C, ‘Note on the Measures Taken to Update the Statistics About French Army Losses’, [?] March 1916.

Table 1. French gas casualties, annual figures: 1915–8

Year	Percentage
1915	22%
1916	22%
1917	15%
1918	19%

SHD, 15N4, document sent to the War Ministry, 16 December 1918. The 1915–7 data were based on estimated figures.

than that of Bernard Marc in his (2004) discussion.⁵³ Their gas mortality estimates vary at 6,100 and 8,000 respectively. But even if these figures may be divergent, it is possible to discern a broad pattern of similarity. It is worth beginning with the French military authorities' own figures, produced in December 1918, of the annual totals of French gas casualties expressed as percentages of total French army casualties (Table 1).⁵⁴

Although the 1915–7 figures are estimated, the statistics nevertheless reveal that following the introduction of chemical warfare by the German army in April 1915, there was a steady decline in gas casualties as a proportion of total casualties in the following 2 years. This pattern was halted and reversed in the final year of the war. Several factors may explain this percentage increase, but it is fortunate for the historian that there is more reliable and more detailed information covering the final calendar year of the war.

A case study in point illustrates casualty numbers relating to the evacuation of soldiers from the First, Third, Fourth, Fifth, Sixth and Tenth Armies covering 7-day periods of action from the 11 August to the 9 October 1918. These reveal a more complex pattern of gas casualties. When aggregated, these statistics, though largely consistent with the general gas casualty picture, nevertheless highlight interesting features and variations. What especially complicates these selective 1918 statistics was the French army's use of multi-categorisation casualty criteria. Three categories of wounded were used: those injured by conventional weapons, those gassed and, finally, those wounded by conventional weapons who were also gassed. The number of fatalities for each group was also recorded. The results provide a more comprehensive and revealing breakdown of gas casualty information as will be shown.

The total number of French gas casualties in the 2-month period of late summer and autumn 1918 was 31 024, of whom 968 died. Of all wounded (including fatalities), 21.25% comprised both groups of those gassed and those wounded and gassed, while the percentage figure for wounded (including fatalities) from gas only was 8.17%. Separated out, the fatality figures as a proportion of total casualties broadly mirror the two nonfatally wounded categories at 17.45% and 8.57%, respectively.⁵⁵ These figures underline both the relatively low proportion of total Western Front battlefield casualties attributed to gas and the low related mortality rates, facts which have been commented on extensively in the literature over the last 80 years.⁵⁶

These interesting results in turn raise an important related question. What proportion of the victims within the mixed (ie., the conventionally wounded and gassed) group were gassed after being initially

⁵³Lepick, *op. cit.* (note 20), 318. See epilogue by Dr Bernard Marc in Bernard Giovanangeli (ed.), *La Guerre des Gaz* (Paris: Bernard Giovanangeli Editions, 2004), 230–1. Marc appears to quote from H.L. Gilchrist, *A Comparative Study of World War Casualties from Gas and Other Weapons* (Edgewood, MD: Chemical Warfare School, 1928), 38–42 and 43–47.

⁵⁴See Table 1 entitled 'French gas casualties, annual figures: 1915–8'.

⁵⁵SHD, 26N126, *Journal des Marches et Des Opérations* of the third bureau, especially 13–8.

⁵⁶There is extensive monographic literature on this subject. See the useful statistical assessments of French, British and German gas casualties in Gilchrist, *op. cit.* (note 53); Rudolph Hanslian, *Der Chemische Krieg* quoted by Haber, *op. cit.* (note 8). See also Official Statistics of the Reich, *Der Weltkrieg 1914–1918: Die Militärischen Operationen zu Lande*, vol. 3 (Berlin: Mittler, 1925), 334; and James Kendall, *Breathe Freely! The Truth About Poison Gas* (London: George Bell, 1938), 139–152, especially Chapters 10–1.

wounded by conventional weapons; and conversely what percentage of the group suffered injury from projectiles after having first been gassed? Unfortunately, this avenue of inquiry appears to be compromised by insufficient data but such information – were it available – could throw further light on the means by which soldiers succumbed to gas contamination on the battlefield.

The year 1918 was an exceptional year in the great gas war, so it is especially fortuitous that more reliable and detailed casualty records were kept. During that year, huge quantities of poison gas were expended.⁵⁷ It also coincided with the use of mustard gas, which dominated the battlefield.⁵⁸ Mustard gas, though not the most chemically lethal of the poison gasses used in the Great War, was nevertheless perhaps the most testing of a soldier's anti-gas discipline.⁵⁹ It is worthwhile to consider these two factors in connection with Lepick's estimate that 61% of all French gas casualties and nearly 46% of all gas fatalities occurred in 1918 alone.⁶⁰

In addition to the expenditure of vast quantities of poison gas in general and of mustard gas in particular, there is a third factor, which appears to have had a complicating effect on the gas saturated battlefield in 1918. That concerns the impact of the return to mobile warfare. Historians of chemical warfare have stressed the fact that, for various reasons, the tactical deployment of poison gas tends generally to immobilise fighting. It is why the stalemate battlefield in France provided such a favourable environment for the use of chemical weapons. It also explains in large part the scale of the gas casualty figures. However, a more mobile pattern of fighting returned to the Western Front from early 1918, initially with the German offensive and concluding with the final and successful allied offensive in the 'last 100 days' – and with it a degree of mobile warfare not seen since 1914. It is important to emphasise, however, that despite the more mobile nature of Western Front warfare in 1918, poison gas continued to be used; so how did this new reality impact upon the casualty statistics? Selective gas casualty figures quoted by Toubert draw attention to extreme variations in the gas casualty experiences of French soldiers attached to one of the Army Groups. For example, when troops rapidly withdrew from the German offensives in March and June 1918, total gas casualties were 3% and 8%, respectively, compared with the 97% and 92% injured by projectiles. However, when the French met severe German resistance in April and May 1918 in the Kemmel region leading to a temporary stasis, 40% of the total French battlefield casualties were due to gassing. When the mobile French offensive resumed at the end of June, the same French Army Group's gas casualty rates were considerably lower.⁶¹ Even so, specific combat episodes resulted in gassing rates as high as 30% of total casualties and as low as 11%.⁶²

This digression into the nature and problems of French gas casualty figures should draw attention to the possible limitations of using this evidence to quantify levels of effectiveness of the RAMC and FMS in general and anti-gas discipline in particular. It also highlights the necessity of qualification when statistical comparisons are drawn between the French, British and American gas casualty experience on the Western Front. British gas casualty statistics will be selectively discussed in the next section of this paper.

⁵⁷SHD, 16N826, a translated German document No. 341, from the second bureau to the first bureau, 'Intoxication in the War due to Gas Agents', 1 January 1918; SHD, 15N04, report from the Head of British Mission to General Foch, 'Translation of a Letter from the British Imperial High Command', 14 August 1918; SHD, 7N1984, letter No. 6397-3/11, from President of Ministry Council to General Governors of Paris and Lyon, 29 September 1918; and SHD, 7N410, report No. 20351, (1st edn, 22 June 1917), from the third bureau (signed by Major General Debeney), 'Instructions Regarding the Organisation of the Use of 'Z' Material', 23 January 1918.

⁵⁸SHD, 7N1984, report No. 42943, from the second bureau to the first bureau, 'Report Based on a German Document from the German High Command Indicating Anti-Gas Defence Against French Yellow Cross Shells', 21 June 1918. Mustard gas shells were marked with yellow crosses, hence the appellation 'Yellow Cross shells'.

⁵⁹Albert Palazzo, *Seeking Victory on the Western Front: The British Army and Chemical Warfare in World War I* (Lincoln Neb: University of Nebraska Press, 2000), 82.

⁶⁰Lepick, *op. cit.* (note 20), 315 and 318.

⁶¹Kemmel is a Flemish town situated in the west of Flanders.

⁶²Toubert, *op. cit.* (note 48), 96.

Britain

Because the recent Anglo-centric revisionist literature has comprehensively explored major aspects of the British and Commonwealth armies' defensive gas warfare, it is perhaps superfluous to dwell generally on this topic here, except indirectly. But a critical assessment of the British army's gas casualty statistics does deserve attention. Much of the mountainous detail within this primary statistical material has yet to be exhaustively evaluated. While this is beyond the scope of the present investigation, an effort will nevertheless be made – using British gas casualty reports – to selectively compare (and contrast) implied levels of British and French anti-gas discipline during two stages of the chemical war campaign. Comparisons that may be drawn must, of course, be qualified by the nature of pre-1918 French statistical evidence, the problems and shortcomings of which were discussed earlier.

In his penetrating 1994 study of the British gas war, Donald Richter drew attention to the daunting physical scale of British gas casualty primary material, which, as he pointed out, was to be found in 'literally hundreds of bulging boxes' in the National Archives. Among what Richter describes as the 'raw data' are many detailed and revealing reports and statistical summaries, several of which will be exploited in the following discussion.⁶³ It is perhaps necessary to point out however that, in contrast to their French allies, the British army – largely through the work of the RAMC – comprehensively collected and centralised gas casualty statistics during much of the chemical war. Brigadier General Foulkes confirmed, in a memo sent in February 1918, '...with the exception of the earliest cylinder attacks, the number of casualties at present unrecorded is relatively unimportant'.⁶⁴ During the initial German gas attacks, no data were collected regarding the number of British and Commonwealth troops killed by poison gas on the battlefield or of gas casualties taken prisoner by the Germans. Nor were the numbers of minor gas casualties who were returned directly to their units from field ambulances known. But as the gas casualty evidence grew, RAMC officers attempted to convert the crude figures into more revealing pictures of the impact of this new form of warfare and, in particular, to draw attention to the lessons and wider implications for improved anti-gas discipline.

It is useful to begin with an analysis of two specific British statistical case studies that highlight both the acute and dynamic nature of anti-gas discipline challenges, the first carried out in 1915–6 during enemy cylinder attacks and the second produced in 1918 during German mustard gas shell bombardments. A report examining British poisoning casualties from German gas cloud attacks made between 19 December 1915 and 8 August 1916 was prepared by Major F. R. Elliott and Captain C. G. Douglas, RAMC. They attempted to draw out both the salient features of the impact of the enemy chemical attacks with the marked statistical variations in casualty experience. Altogether, five German cylinder attacks had occurred, the gas used being a mixture of chlorine and phosgene. The total number of British gas casualties during this 8-month period was 4 204, which included 1 008 fatalities or 23.9%. But the authors noted that the overall figures masked significant variations in specific episodes of gas poisoning. The lowest rate of fatal gas casualties occurred on 19 December 1915 with a figure of 10.8%. But on 8 August 1916, nearly half of all the British gas casualties (46%) had perished. Elliott and Douglas explained this particular incident as a consequence of 'inopportune' timing when 'reliefs were taking place and the trenches were abnormally crowded'.⁶⁵ Their report also confirmed that 'as expected' both casualties and the highest mortalities occurred at those points on the front line, which were nearest to the enemy trenches. The authors stressed the critical importance of vigilance and swift response to alarms as the key to effective anti-gas discipline. The timing of death among casualties was also recorded. The report noted that the heaviest death toll occurred during the first 24 hours following an attack; that the first 48 hours represented 'the really crucial period for the serious cases' but that only a few deaths occurred after the third day.

⁶³ Donald Richter, *Chemical Soldiers: British Gas Warfare in World War One* (Kansas: University Press of Kansas, 1992), 266.

⁶⁴ The National Archives Kew (hereafter abbreviated TNA) WO158/434, report from Foulkes Brigadier General Director of Gas Services, 17 February 1918.

⁶⁵ TNA MUN/197 1650/1-12, report from Major F.R. Elliott and Captain C.G. Douglas to Foulkes, 14 December 1918, on casualties due to gas poisoning resulting from German cloud gas attacks December 1915 to August 1916.

Yet even this relatively early report drew attention to the statistical contrast between the gas casualty rate and its linked mortality rate and the overall casualty picture. Three episodes were singled out for analysis, one in later December 1915 and two chronologically contiguous enemy attacks in late April 1916.⁶⁶ The total number of all British gas casualties involved was 2 841 including 543 fatalities (or 19.1%). But, when expressed as a proportion of the total number of troops involved, the overall rates of gas casualties and its related mortality were 4.1% and 0.73%, respectively.⁶⁷ What the report did not do was to contrast the rate of gas casualties with the overall casualty rate. In addition, it is not known how many of the gas casualties had also received injuries from enemy conventional weapons, and if so, whether they were received before or after being gassed.

The efficiency and quality of British gas masks was discussed obliquely in Elliott and Douglas's report. Initially, in December 1915, the British troops were protected by the fabric 'P' helmet. These were later augmented by the issue of large box respirators to Special Brigade units. But following the introduction of the Small Box Respirator as standard issue from the summer of 1916, the authors noted that British troops faced no subsequent German cylinder gas cloud attacks (Figure 1).⁶⁸

However, and with possible implications for the quality of French army respirators as perceived by the Germans, this method of enemy chemical attack continued to be waged against French forces for almost another year, chloropicrin being the gas usually employed.⁶⁹ On 1 July 1917 at Seichephey, the German army employed gas clouds against the French for the last time.⁷⁰ On that day (according to information in a latter British report), total French gas casualties numbered 450 including 136 fatal poisonings (or 30.22%).⁷¹ The high mortality rates sustained by the French at this stage of the gas war are significant but the German army abandoned cylinder attacks because they were planning to unleash a new chemical warfare agent upon both allied armies: mustard gas.

While the earlier German cylinder gas cloud attacks (mainly of chlorine and phosgene) resulted in the highest mortality rates (as a proportion of gas casualties) for both British and French troops on the Western Front, it was the introduction in July 1917 of mustard gas (or yperite as the French called it) by the enemy that produced the greatest havoc in terms of numbers of allied gas casualties and deaths.⁷² Calculations based on statistics in a British report dated 21 January 1918 indicate that 88% of all British gas casualties (160 526) and 67% of all gas fatalities (4 086) were due to the German army's deployment of this new persistent gas.⁷³ The implications for anti-gas discipline of the 'yellow cross' mustard gas shell attacks were investigated in a further report produced by Lieutenant Colonel Douglas.⁷⁴ His secret report based on a sample of 384 mustard gas casualties in the British Third Army area during the nights of enemy shelling on 11–2 and 12–3 March 1918 was submitted within 10 days of the second attack.⁷⁵

Although Douglas's findings were based on subjective criteria – the casualties were interviewed in five different hospitals and were invited to offer their opinions on when and how they thought they were gassed – the details were nevertheless instructive. While nearly 31% of the casualties said that they had been gassed during the bombardment, over 43% claimed to have been poisoned afterwards. Seventy-four

⁶⁶*Ibid.*

⁶⁷*Ibid.*

⁶⁸TNA WO158/434, report No. 294, from Foulkes Brigadier General Director of Gas Services, 17 December 1918; TNA MUN 142/109, letter No. 32326, from General of Division Herr, General Inspector of Artillery High Commander of General Reserve of Artillery to General Foulkes, 23 December 1918. Liddell Hart Centre for Military Archives, Foulkes 6/44, Diary of Development of British Respirator Chronologically Compiled from 22 April 1915 to 3 January 1919.

⁶⁹Simon Jones, *World War I Gas Warfare Tactics and Equipment* (Oxford: Osprey, 2007), 32.

⁷⁰Seichephey is a village situated in northeast of France as part of Lorraine region within the department of Meurthe-et-Moselle.

⁷¹TNA MUN142/109, *op. cit.* (note 68).

⁷²*Ibid.*

⁷³*Ibid.*

⁷⁴He was described in the report as a physiological advisor to the British Army's Gas Services.

⁷⁵TNA MUN142/109, report from Douglas, the Physiological Adviser of the Gas Services to Foulkes, 'Reports on the Investigation of a Number of Casualties from Gas Shelling with Yellow Cross Shells in the Third Army Area on the Nights 11–2 and 12–3 March 1918,' 23 March 1918.



Figure 1. Protecting man and beast. British army SBR gas mask and horse mask (date and place unknown). Wellcome Archives, PP/CLE/A.3, Charles Lovatt Evans photograph album, 1916–8. Copyright: Wellcome Trust.

per cent maintained that they had been gassed in the open, while over 22% concluded that they had been contaminated in dugouts or shelters. Nearly 4% were uncertain where or how they had been gassed.

What this report highlighted *inter alia* was the vulnerability of troops to the dangers of low concentrations of the gas as a consequence of its slight odour and because it appeared to have no immediate deleterious effect. Even so, the report found no evidence that the new persistent gas paralysed the sense of smell. Douglas assembled a catalogue of errors and omissions in anti-gas discipline, which had collectively created great danger. Major problems concerned the delay in putting on respirators and/or their being removed too early. Nearly 15% of the casualties admitted to not wearing their masks at all during the bombardment, because the area was thought to be free from gas or because their dugout was considered to be adequately protected; while over 44% of victims removed their masks at intervals during the assault. In some cases, this was unavoidable, for example, when officers had to give orders or to find their way to lead troops through difficult ground. One telephonist had discarded his respirator to phone, and gunners had to lower their masks when correcting gun sights, while a medical officer had been compelled to remove his mask to attend to wounded troops.

Carelessness in the use of the respirator after the bombardment was a particularly serious problem because of the latter activation (or reactivation) of the gas.⁷⁶ But Douglas was aware that the victims' statements had to be treated with caution because of the often-extended delay involved with mustard gas poisoning, which would have led casualties to believe that they had been contaminated at a latter period than was, in fact, the case. Over 43% of the casualties admitted that they did not wear their masks at all after the bombardment. Douglas concluded that while the 'bulk' of casualties were gassed in the open,

⁷⁶TNA MUN142/109, summary from C.G. Douglas Lieutenant Colonel R.A.M.C., Physical Advisor Gas Services to Foulkes, 'The General Character of the Casualties', 23 March 1918.

there were a number of instances when large groups of soldiers were poisoned in dugouts and his report investigated these aspects too.⁷⁷ Some shelters were unprotected or inadequately protected against poison gas, while in some cases, the gas alarm was not diffused effectively.⁷⁸

The report found that protective gas curtains in shelters were sometimes dropped too late or had been displaced (or torn) by local shell bursts or merely by men entering shelters. The fact that over 22% of the casualties claimed to have been gassed in dugouts (or shelters) also suggested that the gas had been carried in on soldiers' clothing. However, Douglas maintained that the rarity of skin blistering indicated that the contamination of uniforms was not severe. Severe or not, affected troops still ended up as casualty statistics. As a latter British report pointed out in connection with 'yellow cross' attacks, 'any failure in anti-gas discipline' resulted in an 'undue number of casualties'.⁷⁹ Although mortality rates among mustard gas victims were generally low, the use of this chemical weapon was the most effective in generating casualties who remained unfit for duty for a considerable time. This is what the official euphemism 'material casualties' implied.⁸⁰ The scale of allied 'yellow cross' casualty figures was a sombre acknowledgement of the weapon's devastating impact as a battlefield crippler. As the British report admitted: 'the invaliding power of mustard gas was...very considerable during the war'.⁸¹

Although levels of British and French co-operation in the field of anti-gas warfare appear to have been under-estimated in existing studies, it is not clear how regularly or extensively the allies shared their gas casualty statistics. That the exchange of information was probably patchy is, arguably, inferred from British efforts to obtain further data immediately after the war. The British Gas Service was clearly concerned to know how their army's anti-gas discipline, as measured by the casualty statistics, compared with their allies.⁸² While no exhaustive or even comprehensive comparative surveys appear to have been undertaken, a report from the Director of Gas Services dated 3 February 1919 contained detailed statistical comparisons with French gas casualty experience via their armies' exposure to two major types of enemy chemical attack: cylinder and projector assaults. Even making allowance for the more limited scope of this report, the results are nevertheless revealing.⁸³

Some caution is required when interpreting these figures, especially in view of the nature of pre-1918 French gas casualty statistics – a point not mentioned in the 1919 British report (Tables 2 and 3).⁸⁴ To begin with, however, what seems to be inferred by these figures is that, even in the context of cylinder and projector actions only, the French troops were the main victims of German poison gas attacks against the allies on the Western Front. Some historians have suggested that the French were seen by the German army as the weaker of the two allies in terms of anti-gas defence, which could, in part, account for the more prolonged use of gas clouds against the French forces.⁸⁵ The projector figures are particularly interesting, because this was one weapon in which the British army excelled. They were not only the initiators of the projector – first using the weapon at Arras in April 1917 – but they expended far larger quantities than any other combatant and the German army were known to be fearful of the Livens Projectors, especially when the British employed them in huge simultaneous bombardments, which saturated the enemy trenches with suffocating densities of poison gas, which often overwhelmed the German respirators.⁸⁶ Foulkes attributed the lower British casualty rates from enemy projector attacks to the fact that the German projector drums were smaller than the British weapon and contained only half

⁷⁷TNA MUN142/109, *op. cit.* (note 75).

⁷⁸The role of anti-gas alarms is discussed in Cook, *op. cit.* (note 1), 63–4 and 93.

⁷⁹TNA MUN 142/109, *op. cit.* (note 75).

⁸⁰*Ibid.*

⁸¹*Ibid.*

⁸²TNA MUN 142/109, report No. 284, from Brigadier General Director of Gas Services Foulkes to GHQ, 3 February 1919.

⁸³*Ibid.* See Table 2 'French and British gas casualties due to German cylinder attacks', and Table 3 'French and British gas casualties due to German projector attacks'.

⁸⁴TNA MUN142/109, *op. cit.* (note 75).

⁸⁵Haber, *op. cit.* (note 8), 72–5.

⁸⁶SHD, 16N839, booklet No. S.S. 138/3, issued by the General Staff 'Effect on Enemy of Our Gas Attacks, Third Report for the Period April–July 1917, [?] September 1917.

Table 2. French and British gas casualties due to German cylinder attacks

Period of attacks	French army losses (19 October 1915 to 1 July 1917)	British army losses (19 December 1915 to 8 August 1916)
Total no. of attacks	11	5
Total no. of casualties (deaths and 'gassed')	10 511	4 202
Total no. of nonfatal gassed casualties	8 522	3 196
Total no. of fatal casualties	1 989	1 008
Average no. of all casualties per attack	955.5	840.8
Average no. of nonfatal casualties per attack	774.7	639.2
Average no. of fatal casualties per attack	180.8	201.6
Overall mortality rate (deaths from gassing as a percentage of gas casualties)	18.9%	24%

Based on information in TNA MUN 142/109, report from Brigadier General Director of gas services, 3 February 1919.

Table 3. French and British gas casualties due to German projector attacks

Period of attacks	French army losses (5 December 1917 to 30 November 1918)	British army losses (11 December 1917 to 31 May 1918)
Total no. of attacks	40	16
Total no. of casualties (deaths and 'gassed')	2 895	444
Total no. of nonfatal gassed casualties	1 948	363
Total no. of fatal casualties	650	81
Average no. of all casualties per attack	65	27.8
Average no. of nonfatal casualties per attack	48.7	22.7
Average no. of fatal casualties per attack	16.3	5.1
Overall mortality rate (deaths from gassing as a percentage of gas casualties)	25.4%	18.2%

Based on information in TNA MUN 142/109, report from Brigadier General Director of gas services, 3 February 1919.

the quantity of gas.⁸⁷ Nevertheless, the British casualty rates in the face of this weapon were not only lower than the French but also significantly lower than those of the American Expeditionary Force and the Belgian army.⁸⁸

While the French figures for cylinder attack losses may be under-estimated, the overall mortality rates for the two allies appear roughly comparable, with the British projector rates (18.2%) being almost mirror images of the French cylinder rates (18.9%) and vice versa. The 1919 British report, which assembled these data, drew the somewhat self-evident conclusion that 'British gas discipline was better

⁸⁷C.H. Foulkes, *Gas! The Story of the Special Brigade* ([1934] Uckfield: Naval and Military Press, 2002), 332.

⁸⁸TNA MUN 142/109, *op. cit.* (note 75). The report does not explain the discrepancy in the French and British figures.

and the protection was much more efficient during the projector [period] than it was during the cylinder attack period'.⁸⁹ A serious omission in the report was, of course, any mention of the complicating impact of the German use of mustard gas from 1917 upon levels of allied anti-gas discipline and the overall management of their medical services. In terms of comparisons with its allies, the report stressed that during the projector period, British gas masks were 'about equal' in efficiency to American respirators but superior to French masks even though it was conceded that these were more comfortable to wear. Its overall conclusion, expressed rather pedantically, was that British anti-gas discipline during the latter stages of the war 'did not compare unfavourably with its allies', and in a final dart of institutional self-justification, it was stated that 'good value' had been obtained from British organisations established for the purposes of enhancing gas defence.⁹⁰

Explaining the apparent concurrence of the French and British armies' levels of anti-gas discipline, as indicated by the casualty statistics, is complicated by many factors, not least because the two allies prosecuted their respective gas wars in what appeared to be a wholly self-contained fashion. Was the similarity in their overall gas casualty rates largely a co-incidence or was there a hidden dimension to this convergence of experience? One possible line of explanation concerns the contribution of an evolving programme of bilateral anti-gas co-operation initiatives, which began at the start of the chemical war and which informed both armies' defensive gas warfare efforts.

The gas war and the threat to allied civilians

There were certain pressures on the French military hierarchy, which appear to explain their heightened concern with defensive gas warfare and maintaining national security. The physical and psychological effects of the initial German chemical attacks upon ill-protected troops had been painfully demonstrated not only to the High Command but to the population at large through the, albeit filtered, newspaper coverage. Failure to safeguard front-line troops had potentially serious implications for the morale of all soldiers on the Western Front. And unlike their British and Commonwealth allies, the French authorities had the additional responsibility of protecting French civilians living near the front. Even so, it was necessary to reassure all civilians that the authorities had the chemical weapon threat under control and that the safety of citizens (whether in uniform or not) was being given the highest priority. To that end, morale-boosting reports of the latest advances in anti-gas protective equipment were made public via the press, at least during the initial phase of the chemical war. Letters, memos and reports exchanged between the departments of the War Ministry attest to an increasing level of official concern over this issue by the end of 1915. This reached peaks of intensity towards the end of 1916 and in 1918. Unfortunately, the poison gas threat to French civilians remains an under-explored niche in the wider great gas war historiography.⁹¹

French civilians in affected areas were subject to a widening regime of anti-gas protection. The French High Command first bureau stipulated a number of measures to protect civilians residing at a distance within 6–8km of the front from asphyxiating gas clouds. They had to collect goggles, compresses and Tambuet Masks from their town hall. The FMS dispatched Doctors and nurses to each community to explain to civilians how to wear their protective equipment correctly. When the military alarm was raised, civilians were instructed to go to the first floor of their houses, shut doors and windows and remain there until the all-clear.⁹²

A new and significant tactical development in the great gas war occurred in January 1917 when German aircraft attacked the French North and East Army Groups using gas bombs for the first time. The bombs were not jettisoned from purpose-built wing-mounted bomb racks but – according to a secret

⁸⁹*Ibid.*

⁹⁰*Ibid.*

⁹¹Haber, *op. cit.* (note 8), 193 and 205–6; see also Girard, *op. cit.* (note 6), especially Chapter 5.

⁹²SHD, 16N839, letter No. 630/1, from the C-in-C to Quartier General, 29 January 1916.

report compiled by the French second bureau – were simply hurled out of the cockpits of the attacking planes.⁹³ Notwithstanding the improvised, if crude, nature of the means of delivery, this extension of the gas war had worrying, and not just military, implications for the allies. News of air-launched chemical weapons spread beyond the combatants and to an increasingly alarmed French civilian population. The aerial gas scare escalated by the summer of 1917 as worried civic leaders approached the military authorities for reassurance and action. For example, mayor Lugol of Meaux, articulating the concerns of French communities potentially threatened by German gas operations, asked the French High Command if civilians would be the target of chemical weapons dropped by enemy aircraft. He also expressed his community's dissatisfaction with the existing levels of official anti-gas protection for civilians by requesting additional defensive measures such as the provision of underground public gas shelters.⁹⁴

The spectre of civilian vulnerability to the aerial projection of chemical and biological warfare had, in fact, been raised a year earlier when the second bureau alerted the French High Command to a disturbing incident in Italy. On 12 February 1916, German aircraft were reported to have dropped poisoned sweets on Codigoro.⁹⁵ A young girl was rushed to hospital, vomiting and suffering from fever, while an analysis of the sweets indicated the presence of pathogens. Although the incident was not reported in the French press at the time, the French High Command urged all front-line towns and villages to be vigilant and civilians were advised to avoid contact with suspicious or unfamiliar objects.⁹⁶ As it transpired, this was an isolated and independently unconfirmed incident, but it suggests how fearful the military and civilian authorities were about the possible threat.⁹⁷

The alleged German attempt to attack [Italian] civilians in February 1916 was not without a counter-claim. Later that year, the German press reported that the French had dropped gas bombs on civilians in Metz. The *Berliner Tagblatt* and the *Frankfurter Zeitung* in their issues of 28 October 1916 claimed that five civilians had been killed and another seven wounded in the attack. Details of these press reports were recorded in a file by the second bureau but without comment.⁹⁸ The German reports (like the French ones above) do not appear to have been independently verified, and there are compelling reasons to suggest that this was little more than a propaganda invention.⁹⁹ The French were reluctant to escalate the gas war against Germany by targeting enemy civilians from the air given the greater vulnerability of their own civilian population to such attacks. In addition, the military and political authorities were aware of the wider implications of such an initiative. It could also be argued that as the leading innovator of the Western Front gas war, the Germans would have been unlikely to tolerate French aerial gas attacks on their civilian population without a significant retaliatory response. The German press reports could, of course, have been used as a pretext for a future air-launched chemical war initiative of the German forces against French civilians. However, it is perhaps worth pointing out that there are no references in the military archives at Vincennes (*Services Terre/Air*) to French-made gas bombs but substantial volumes of material survive, which describe other French-made gas weapons. The Western Front was not just submerged in poison gas: it was also saturated with propaganda.

⁹³SHD, 16N839, letter No. 7036, from the second bureau, 20 January 1917.

⁹⁴SHD, 16N839, letter from Lugol, Mayor of Meaux to the C-in-C, 19 July 1917.

⁹⁵Codigoro is an Italian village situated in the province of Ferrare and the region of Emilia Romagna (northeast Italy).

⁹⁶SHD, 16N839, letter No. 553 R.S., by Colonel Di Breganze, Chief of the Italian Military Mission to Colonel Dupont, Chief of the second bureau, 29 February 1916.

⁹⁷Girard, *op. cit.* (note 6), 84–5.

⁹⁸SHD, 16N839, copies of German articles dated 28 October 1916 compiled by the second bureau (there is no reference to the sender or receiver and the document is undated).

⁹⁹H. Magne and D. Cordier, *Les Gaz de Combat au Point de Vue Physiologique, Médical et Militaire* (Paris: Baillière et Fils, 1936), 162; Charles Hederer and Marc Istin, *L'Arme Chimique et ses Blessures, Etudes Générale Sur les Gaz de Guerre* (Paris: Baillière, 1935), 689–697; André Meyer, *Les Gaz de Combat* (Paris: Charles Lavauzelle et Cie, 1939), 141; and Yves Buffetaut, *La Première Attaque aux Gaz* (Louvriers: Ysec, 2003), 7–12 and 75–79. See also Jacques Parisot, 'La Protection Contre le Danger Aérochimique: Rôle des Infirmières, Secouristes et Assistantes du Devoir National' (unpublished PhD thesis:[s.n.], 1932), vol.1, 122–129; and Alain Cambariou, 'La Guerre des Gaz 1915–1918 Mise en Perspective Historique du Témoinage du Docteur Paul Voivnel' (unpublished PhD thesis: University Paul Sabatier, 2002).

In spite of the precautions taken by the French High Command to protect civilians, a number of them were nevertheless gassed during the German ground attack on Dunkirk on 1 May 1917.¹⁰⁰ As a response, the zone of protection was extended from 8km to 15km and M2 masks were modified so that children could wear them.¹⁰¹ However, the threat that loomed in 1918 among the exposed civilian population was the inability of existing gas masks to protect wearers from mustard gas. Initially, the only recommendation provided by the French War Ministry was to flee any contaminated spot in the event of mustard gas attack. Such despairing advice underlined the acute challenges posed by the dynamic nature of the great gas war on the Western Front.¹⁰²

The German bombing raids on Paris in late 1917 and early 1918 combined with their introduction of mustard gas on the Western Front raised new French fears about the possibility of civilian gas casualties. Senator Paul Cazeneuve was an eminent figure who liaised with French politicians, scientists, physicians and inventors, and he regularly presented reports to the French Senate updating them on the latest developments in gas warfare. In a report presented to the French Senate on 1 February 1918, he began by asking two basic questions. Were individual civilians in towns adequately protected against German gas bombs and did the FMS provide all the necessary equipment for the collective protection of civilians? Although he did not specifically answer either question, he nevertheless attempted to reassure his audience by pointing out why the Germans were unlikely to target civilians with aerial gas attacks.

Essentially, Cazeneuve argued such an initiative would be tactically futile and technically impossible. He maintained that, in the opinion of ‘highly competent engineers and researchers’, any effective deployment of (liquid) mustard gas from the air would require a bombing force beyond the enemy’s capabilities. Indeed, he claimed that ‘tons and tons’ of gas would have to be unleashed ‘for any danger to be visible’, whereas the maximum payload of an enemy aircraft was only 300kg. This led Cazeneuve to confidently anticipate that any citizen ‘could *easily* [my italics] escape such an attack’¹⁰³ although the experience of even battle-hardened troops with excellent anti-gas discipline indicated otherwise.¹⁰⁴ More pragmatically, he invoked the *status quo* by reminding his audience that French towns on the front line that had been contaminated with mustard gas – he singled out Armentières as an example – had not been gas bombed by aircraft.

As a specimen of morale-enhancing propaganda, Cazeneuve’s report was conspicuously evasive and misleading. He was evidently unwilling or unable to satisfactorily answer his own questions about the ability of the French authorities to adequately protect the civilian population from gas attacks, which could now include the particularly menacing mustard gas. Cazeneuve’s grasp of the dangerous and unstable properties of mustard gas was evidently limited while his confidence in the ability of French civilians to evade injury from its deployment was, to say the least, naïve.

There were a number of other uncomfortable and unspoken home truths absent from his report. To begin with, the telling psychological impact of German conventional bombing sorties upon British and French civilian targets, especially from 1917, appeared to be disproportionately high in relation to the scale of these attacks. By focusing on the more improbable scenario of mass attacks, Cazeneuve failed to address, deliberately or otherwise, the possible consequences upon civilian morale and physical well-being of limited or even token aerial gas attacks, which the Germans had the means to deliver. By contrast, even by the autumn of 1918, the allies still lacked operational heavy bombers with sufficient range to retaliate in kind, although this situation was about to change. However selective his evidence and however disingenuous his arguments, Cazeneuve’s report is nevertheless an illuminating and suggestive,

¹⁰⁰SHD, 16N837, report from the head of Medico-Legal Centre Dr Major Boutin to the C-in-C, 31 July 1917. The exact number of the gassed residents of Hondschoots was not stated by the report transmitted by the Interior Ministry to the War Ministry.

¹⁰¹SHD, 16N837, letter No. 19126, from Commander of the North Army Group to the C-in-C, 3 May 1917. For infants, the French Gas Service developed a special shelter with extra ventilation and neutralising agents. In March 1918, a school in Boulogne received 7 000 TN Masks and 7 000 pairs of goggles.

¹⁰²SHD, 16N838, letter No. 69, from the Medical Service to the C-in-C, 28 March 1918.

¹⁰³SHD, 6N296, report No. 47, from Cazeneuve to the French Parliament, 1 February 1918.

¹⁰⁴Cook, *op. cit.* (note 1), 57–8.

if paradoxical, confirmation that the French High Command's concern about the danger of civilian exposure to aerial gas attack remained undiminished in the final year of the Great War.¹⁰⁵

The French High Command shared their political leaders' concerns about the protection of civilians from gas contamination. The British military authorities were not, however, spared this additional dimension of anxiety just because British civilians were far removed geographically from the fighting zones. The ominous introduction of air-delivered gas weapons on the Western Front by the German air arm from 1917 had potentially serious implications for the British given the vulnerability of civilians in the British Isles to German bombing, especially following the Gotha raids that had aroused such public alarm.¹⁰⁶ Some earlier, albeit isolated, British press reports had reprinted accounts of alleged German threats to extend the gas war to Britain via aerial assault.¹⁰⁷ In one of the official British histories of the Second World War, it was suggested that from the summer of 1917, 'there was talk, doubtless originating from troops on leave from Flanders, that the enemy would soon employ poison gas against the British people in their homes'.¹⁰⁸ These threats and fears were not without foundation. According to Ludwig Haber, the Germans had initially discussed the possible use of Zeppelins for delivering gas bombs, but Falkenhayn had over-ruled such suggestions. Later, in 1917, the idea of dropping poison gas on civilian targets from German heavy bombers had been considered but was vetoed by Ludendorff because of the concern of allied reprisal raids on German border areas such as the Saar.¹⁰⁹

The possibility of such a serious escalation of the war was considered by the British war cabinet and by the Smuts Committee on the defence of London where the idea of supplying gas masks to the metropolitan civilian population was rejected. Although French and Belgian civilians had been supplied with and trained to use respirators – sometimes by the British – the British war cabinet concluded that it would be 'impossible to train the London population' to put on gas masks.¹¹⁰ Such was the nature of official thinking in World War I. Yet within 20 years and in anticipation of a future gas war, millions of British men, women and children would be doing just that.¹¹¹

But one group of civilians had already experienced the physical (and psychological) hazards of contact with mustard gas: war workers.¹¹² The toxic and tenacious characteristics of mustard gas generated a multitude of dangers to the health and well-being of operatives in the production plants in Germany, France, Britain and the United States.¹¹³ Injuries were usually created through contact with either garments or machinery. Touching a contaminated area could result in burns and blisters. Parts of the

¹⁰⁵For a highly detailed chronological account of the Zeppelin and 'Gotha' attacks on Britain, see Christopher Cole and E.F. Cheesman, *The Air Defence of Britain 1914–1918* (London: Putman, 1984), 430–1 and 486. The scale of the problem confronting British air defences and its resolution is summarised in Chapter XXII. According to Joseph Morris, 9 000 German bombs weighing a total of 280 tons were dropped on British soil during the course of fifty-one airship and fifty-two airplane attacks, killing 1 413 and wounding a further 3 408. Over half of the casualties occurred in London. Captain Joseph Morris, *The German Air Raids on Great Britain* ([1925] Gloucester: Nonsuch, 2007), 15. A recent BBC Television 'Timewatch' documentary dealing with what it called the First Blitz was almost entirely preoccupied with the German Zeppelin raids. Virtually nothing was said about the Gotha and gigantic bomber attacks in 1917–8. The programme was broadcast on BBC 2 on 2 February 2007.

¹⁰⁶Malcolm Cooper, *The Birth of Independent Air Power. British Air Policy in the First World War* (Boston: Allen and Unwin, 1986), 97–100.

¹⁰⁷See, for example, *Illustrated Sunday Herald*, 13 June 1915, and *Daily Graphic*, 7 July 1915.

¹⁰⁸Terence O'Brien, *Civil Defence. [History of the Second World War. United Kingdom, Civil Series]* (London: HMSO, 1955), 10.

¹⁰⁹Haber, *op. cit.* (note 8), 205. Erich Frederick Wilhelm Ludendorff (1865–1937). He was appointed in 1916 as *General-quartiermeister* which made him joint military head with von Hindenburg of Imperial Germany's High Command. He remained in this post until his resignation in October 1918.

¹¹⁰*Ibid.*

¹¹¹Angus Calder, *The People's War Britain 1939–45* (London: Jonathan Cape, 1969), 25–6.

¹¹²Accidents also occurred in the production of nonpersistent gases, such as chlorine, but these were on a smaller scale. The largely nonlethal hazards of chlorine production in the pre-World War I period were described in contemporary literature. See Thomas Oliver (ed.), *Dangerous Trade. The Historical, Social, and Legal Aspects of Industrial Occupations as Affecting Health, by a Number of Experts* (London: John Murray, 1902), 578.

¹¹³Fitzgerald *op. cit.* (note 3), 619; and Lieutenant David Sbrava, *La Guerre des Gaz 1915–1918 Vue à Travers les Archives de l'ECPAD* (Ivry-sur-Seine: Documentaliste ECPAD, 2011), 4.

human body dump with perspiration were most vulnerable.¹¹⁴ Extended handling of the toxic agents could provoke a range of clinical disorders such as gastric pains, chronic cough, memory weaknesses and mental inertia.¹¹⁵ In France, workers at the Roussillon factory, as well as the plants in Pont-de-Claix, Angoulême and the plants of Savonnerie and Stearinerie in Lyon, suffered from unsafe working conditions while handling mustard gas chemicals.¹¹⁶ Haber maintained that filling artillery gas shells was the most unsafe job in the wartime chemical industry with German workers suffering as much as their French, British and American counterparts.¹¹⁷

Notwithstanding attempts to mitigate the dangers to chemical workers by the implementation of additional safety procedures, improved ventilation and the permanent presence of professional medical staff, gas weapon production continued to present a high risk to workers as reflected in the soaring rates of injuries and absenteeism.¹¹⁸ At the Avonmouth plant, near Bristol England, there were 160 accidents in 1918 with three fatalities. Mustard gas was responsible for temporarily disabling 710 workers and causing 1 400 related mustard gas illnesses. The number of victims treated at the factory was 5 600.¹¹⁹ Despite the menace that mustard gas production created, conventional munitions' factories continued to present a far bigger lethal risk to industrial workers. In Britain, for example, an explosion at a munitions' factory in Faversham (Kent) killed 105 people in March 1916. In Silvertown (East London), seventy-three people were killed and 400 injured in January 1917, while in 1918, an explosion at the National Filling factory Chilwell killed 137 workers. During the Great War, around 600 industrial workers in Britain alone were killed in accidental explosions. These were often caused by the detonation of TNT or amatol.¹²⁰

Conclusion

French and British responses to the coming of chemical war on the Western Front were characterised by both convergence and, in certain respects, divergence. Both allies had set out to address a common imperative: to protect their troops (and in the case of France, their geographically more vulnerable civilians) from chemical poisoning. But how they realised these broad objectives was a deeper reflection of their distinctive national approaches to the solution of military problems and challenges. This manifested itself in the highly contrasting organisational structures of their respective gas services and in the creation of their own, largely unique, ranges of modern defensive and offensive gas warfare equipment and weaponry. The critical examination of casualty statistics revealed remarkably similar British and French gas casualty rates and by implication matching standards of anti-gas discipline. While

¹¹⁴TNA 142/225, Captain [?] Roberts, 'H.S. Manufacture at Avonmouth from the Medical Aspect', 15–6. For instance, at the Avonmouth plant, reports enumerate injury to hands, scalp, shoulders, arms, abdomen, genitals, thighs, legs and feet.

¹¹⁵*Ibid.*

¹¹⁶SHD, 6N296, report No. 47, from Cazeneuve to the Senate, 'Anti-Gas Equipment and Chemical Weaponry up to 1 November 1918', 20 November 1918. The Roussillon factory was responsible for around 75% of the total French mustard gas production of 1 751 tons. The liquid chlorine plant in Pont-de-Claix manufactured 300 tons of mustard gas, while the factory at Angoulême turned out 80 tons. An additional 90 tons came from the plants of Savonnerie and Stearinerie in Lyon.

¹¹⁷Haber, *op. cit.* (note 8), 251. See also Industrial Fatigue Research Board, *The Output of Women Workers in Relation to Hours of Work in Shell-Making*, Report No. 2 (London: His Majesty's Stationary Office, 1919), 15–20.

¹¹⁸TNA 142/225 (note 114), 15–6. In the long run, workers were allowed a rotational scheme, which gave them a week off for every 20 days in the factory. The house rule dictated that health personnel had to be present during working hours, which guaranteed medical treatments to anyone at the plant who could show gas-related symptoms. The main goals of treatments were simple: prevent infections, lung ailments and avoid 'scars' that would 'impair the workers' future usefulness'. Archival evidence indicates that medical practitioners tested an assortment of procedures such as 'hot fomentations in severe (eye) cases and instilling of warm paraffin and cocaine when the lids could be opened'. Then, workers had to repose in a dark place and take time off work.

¹¹⁹TNA 142/225, 17, 'History of the Ministry of Munitions', 63. Many lethal incidents were not reported in the press due to wartime censorship restrictions.

¹²⁰<https://historicengland.org.uk/whats-new/first-world-war-home-front/what-we-already-know/land/first-world-war-accidental-explosions/>, accessed 13 August 2019.

this was not readily explicable given the allies' separate prosecution of the chemical war, it is possible that rather than being mere coincidence one needs to investigate the cumulative impact of (hitherto under-investigated) allied anti-gas co-operative initiatives might provide some explanatory clues. For the French authorities, the danger to civilians posed by the coming of the chemical war created additional responsibilities and anxieties, the implications of which may have restricted their freedom and weakened their resolve to exploit offensive initiatives. A reluctance to unleash newly developed gases upon the enemy would have been consistent with concerns about the consequences for civilians of possible retaliation and escalation by the German army. When in 1915 the French and the British agreed, for 'humanitarian reasons',¹²¹ to ban the use of phosgene and what was then considered to be the most dangerous chemical substance of all – prussic acid gas – it is likely that the safety of French (and Belgian) civilians was one of the considerations. While such a prohibition would appear to strengthen the argument concerning French ambivalence in the gas war, it should nevertheless be pointed out that in the face of the critical military situation the following year at Verdun and the Somme the French (and British) bans were overturned. Indeed, both gases were used against the Germans in 1916.¹²² But evidence of French uneasiness can be found even during the final year of the conflict. The willingness of French representatives at a Red Cross conference early in 1918 to respond favourably to a German government offer to abandon the use of chemical weapons provoked an angry response from the British. Churchill, the Minister of Munitions, extolled the opposite course of action, urging upon the French 'the greatest possible development' of gas warfare.¹²³ After what may have been some internal misunderstanding or disagreement among officials, the French retracted their offer. Their government eventually decided that there would be no formal response to the German offer while judgement on the matter was to be left, as the Foreign Ministry explained, 'to the public conscience'.¹²⁴

The extent to which the perceived vulnerability of their civilian population complicated tactical and even strategic decisions for the French in their conduct of the gas war remains open to question. While there are indications and even evidence of official ambivalence, it is important to juxtapose them with the scale of the French contribution to the allied chemical campaign, for French production and expenditure of poison gas eclipsed that of their British ally almost by a factor of two. Even so, as the French may have had to remind their British and Commonwealth allies, the gas war was largely fought on their native soil. It is this consideration, above all, that seems to explain the *Janus*-like features of French commitment and ambivalence in the chemical war.

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¹²¹Foulkes, *op. cit.* (note 87), 322.

¹²²Foulkes, *op. cit.* (note 87), 304–5.

¹²³SHD, 5N364, letter No. 5514, from the French Minister of Armaments and War Production to the President of Minister Council for War, enclosing a copy of Churchill's letter, 16 April 1918.

¹²⁴*Ibid.*