

South Africa's Secret Chemical Weapons Project, 1933-1945

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Abstract

Recent scholarship has drawn attention to the chemical and biological weapons 'Project Coast' in the final phase of the apartheid regime. The earlier history of the production of chemical weapons in South Africa has received relatively little attention and some aspects have never been discussed before. Pointing to the need for protecting the white minority against indigenous unrest, the South African government showed considerable interest in acquiring the skills and logistics for the production of poison gas in collaboration with Great Britain in the 1930s. It was only after the start of the Second World War, however, that the British were prepared to support a South African chemical weapons programme because it contributed to the Allied war effort. Two poison gas factories were maintained in South Africa until the production of chemical weapons was terminated towards the end of the war despite an occasionally articulated desire by the government to continue with the project. This article will explore the continuities and discontinuities of South Africa's endeavours in producing poison gas within a wider local and international context of chemical weapons policies from the First to the Second World War.

Keywords: Poison gas; South Africa; Great Britain

From January 1946, a series of brief articles in the Johannesburg *Rand Daily Mail* informed the hitherto ignorant South African public that the Union had been involved in a secret chemical weapons project during the Second World War. Starting innocuously enough, the newspaper reported that a new 'Grenade' brand of DDT had been launched by a factory that was controlled by the Defence Department.¹ A few weeks later, the newspaper fleetingly mentioned that in fact two factories had produced 'war gases' in South Africa.² These news were followed by reports of the dumping of more than 3000 tons of poison gas containers about 40 miles off Port Elizabeth.³ Soon afterwards it emerged that several fishing trawlers had caught containers of the hazardous chemical in their nets, sending a dozen fishermen to hospital, at least one of them in a serious condition.⁴ The affected area was banned for fishing, but the authorities refused to divulge any more details.⁵ Finally, a brief news story proclaimed that all stocks of chemical weapons had been destroyed and both factories, at Firgrove at the Cape and Modderfontein in the Transvaal, had been dismantled, marking the end of the production of poison gas in the Union.⁶

Equally hidden from public view were South African attempts to gain access to the industrial resources and skills for the production of chemical weapons in the 1930s. Before discussing the collaboration between South Africa and Britain in the production of mustard gas during the Second World War, this article will explore the as yet unknown early endeavours made by a

South African government to establish a chemical weapons programme. It will be shown that these attempts were unsuccessful because Britain was hesitant to share resources and know-how with a dominion whose loyalty was tarnished by a vociferous anti-British Afrikaner nationalism. But the advent of another world war saw the inauguration of a new government under the banner of collaboration with the British Empire. Far from the theatres of war, South Africa became a hub of industrial productivity in the service of the Allied war effort.⁷ The mobilisation of massive resources in the struggle against the Axis powers included a secret chemical weapons project.

The pre-war South African interest in the acquisition of chemical weapons, however, was as much hampered as vigorously articulated by the Minister of Defence, Oswald Pirow. The ambitious son of German immigrants was as much admired for his dynamism as he was distrusted for his admiration of fascist leaders, which did not endear him to all decision-makers in London.⁸ He repeatedly requested the launch of a South African chemical weapons programme, pointing to the security concerns of the white minority in the face of the black majority. It was only after his exit from the government in 1939, however, that the production of chemical weapons began in South Africa as part of the Allied war effort. Thus, the war shifted the rationale of the manufacture of chemical weapons. Initially motivated by the diffuse but all-pervasive fear that white supremacy was continually threatened by 'the natives', the Union now joined the ranks of the producers of chemical weapons for different reasons. The country at the southern tip of the African continent was considered a safe place for a collaborative secret weapons programme. This article will argue, however, that white apprehensions in the face of a large black majority remained a vague but an underlying aspect, judging from the sporadic requests by the South Africans for permission to keep some gas supplies for themselves. The aspiration of adding poison gas to the South African arsenal did not lead to a sustained effort in the production of chemical weapons, and much less to the formulation of a gas doctrine, but the haphazard efforts undertaken to acquire this military technology reflect anxieties that white supremacy was constantly contested.

South Africa's attempts to establish a chemical weapons programme in the 1930s

At a meeting of the Committee of Imperial Defence (CID) in July 1933 in London Pirow gave a brief overview of the security situation in the Union.⁹ Responding to British criticism of the dominion's reticence in committing itself to the joint defence of the British Empire, he averred that Afrikaner nationalist sentiment precluded the Union from becoming embroiled in Britain's wars outside South Africa. He hinted, however, that the Union might not be averse to help safeguarding white supremacy on the continent beyond South African borders. White South Africans might consider fighting in other African theatres of war, such as Kenya, Uganda and Tanganyika, if some conflict would necessitate the protection of whites against 'natives'.¹⁰ Turning again to the situation in the Union, Pirow assured the other committee members¹¹ that the highly militarised police force, in conjunction with artillery, tanks and aircraft, could be relied on to deal with any eventuality of domestic unrest.¹² Irrespective of this confident declaration of strength, however, Pirow insisted on bringing up 'the question of using bombing and gas in time of war'. Pointing to 'the considerable experience' with these methods in South Africa, he claimed that the Union government was 'definitely convinced that for dealing with native troubles gas and bombs were the most humane and effective method', and he emphasised that he envisaged the use of these weapons 'for police purposes', i.e. for situations of internal unrest.¹³ Pirow explicitly referred to the Bondelswart Rebellion in Namibia in 1922 when South African airplanes bombed and killed about 100 Africans, including women and children.¹⁴ As early as in 1931 Pirow, then the Minister of Justice, already made a similar statement to a

member of the German Consulate General in Pretoria. Pirow declared that he wanted to roll back the British influence on civil aviation in South Africa because he worried about the consequential 'Anglicisation of military aviation' in South Africa.¹⁵ Signalling his interest in buying German aircraft to thwart British dominance, he praised the quality of Junkers airplanes because they could easily be equipped with 'machine guns and gas bombs' to deal with indigenous resistance.¹⁶

The CID chair, Stanley Baldwin, cautiously replied that Pirow's appraisal of chemical weapons and airpower should not be seen to interfere with the expected findings of the ongoing Geneva Disarmament Conference (1932-1935). Baldwin's guarded reaction was apparently not echoed by any of the other attendants. The Union High Commissioner in London, Charles Te Water, merely pointed out that the British government in India also wanted to keep the chemical weapons option open.¹⁷

In September 1934 Pirow reiterated his interest in the implementation of a secret gas production programme for the purpose of dealing with a fictional black mob killing whites in a conversation with a member of the British High Commission in Pretoria. He mentioned to Percivale Liesching that he had sent an officer to Britain for further military consultations. He emphasised that gas remained 'the most important matter to be discussed'.¹⁸ Criticising the British for their perceived lack of interest in the advancement of chemical weapons, Pirow again darkly alluded to the use of chemical weapons in the face of unspecified threats emanating from the African population: 'Personally he was not content to envisage with equanimity the bayoneting of Europeans by Askaris in a war, if the latter could be disposed of by the use of gas'.¹⁹ Pirow informed Liesching that he intended to develop the skills and infrastructure for the production of gas in South Africa, preferably with the help of a chemical weapons expert from the United Kingdom who 'could probably be camouflaged as a Professor attached to Witwatersrand University or to Pretoria University'.²⁰ Pirow's repeated references to the use of 'gas and bombs' and 'machine guns and gas bombs' against Africans, and alluding to the mass killing of indigenous Namibians, indicates that the Minister of Defence was not insisting on secrecy merely to protect the local manufacturing of tear gas for the control of unruly crowds. Thus, the officer sent by Pirow to Britain, Colonel Hoare, visited British gas production facilities in 1934 with a view towards gathering information on more potent chemical weapons. He reported back that the production of poison gas in South Africa would not pose serious technical difficulties, although scientific backup from Britain would be needed. Hoare recommended the production of mustard gas. The main ingredient of mustard gas was ethylene glycol which Britain was expected to ship to South Africa since it was not available in the Union.²¹ Until the end of the Second World War, mustard gas 'stood at the forefront' of the research conducted at Porton Down.²² Its code HS was said to stand for 'Hun Stuff' in allusion to its German inventors, and it had been especially feared by soldiers in the Great War since the Germans used it for the first time in 1917.²³ Even though rarely resulting in death, attacks with mustard gas could cause significant psychological trauma and confusion on the battle field because the vesicant can penetrate clothing and enter the respiratory system with debilitating consequences.²⁴ This project clearly kept Pirow preoccupied, as indicated by another remark he made about 'erecting a gas factory' in South Africa towards a British representative in July 1937.²⁵

Pirow's energetic pursuit of a chemical weapons project reverberated with fears deeply ingrained among white South Africans that white supremacy in the segregationist state needed constant vigilance and had to be defended by military means if necessary. These apprehensions intensified when the Italo-Ethiopian War (1935-1936) generated concerns that the country's

geographical isolation no longer protected it from foreign aggression. The conflict agitated observers not only because of the use of poison gas by the Italian aggressors but it also fostered suspicions that the war in East Africa heralded a new chapter in the European imperialist scramble and made the Union vulnerable to aerial attacks.²⁶ Pirow, speaking at the opening of the revamped aerodrome of the Johannesburg Light Plane Club a few weeks after the Italian assault on Ethiopia, donned the mantle of a prophet of doom by predicting that in the near future the Rand 'could be bombed from places like Madagascar, Tanganyika, Portuguese East Africa, the Congo and Angola'. 'For the first time since the Battle of Trafalgar', he continued, South Africa might be exposed to external attacks.²⁷ Some observers suspected that Pirow's recurrent allusions to a 'black menace' were made for tactical reasons to gain support for his endeavours of modernising the small and backward Union Defence Forces (UDF).²⁸ In the imagination of many whites, however, the combined spectre of domestic indigenous unrest and murderous 'askaris'²⁹ gained even more salience when rumours began to spread that the Italians intended to recruit masses of black auxiliaries.³⁰ Equipping Africans with firearms was anathema to white South Africans.

There was no international agreement that would have banned South Africa from producing and stockpiling poison gas and tear gas. There were, however, a number of external and domestic reasons for keeping such plans under wraps. At the broadest level, Pirow's request to 'camouflage' the production of gas in South Africa reflected the controversial reputation of chemical weapons in the aftermath of the First World War. Ulf Schmidt has emphasised secrecy as the defining aspect of the development of chemical and biological weapons at Britain's research facility at Porton Down and its subsidiaries in India and Australia. He points out that 'throughout most of the twentieth century, the British government neither denied nor officially confirmed the existence of Porton Down'.³¹

The Hague Conferences of 1899 and 1907 shunned the use of poisonous substances in warfare even before modern chemical weapons were invented. Harking back to a martial ethos that despised poison as cowardly and as a devious 'feminine' way of killing in contrast to man-to-man combat there was a near universal condemnation of poison gas. The Germans were the first belligerents in the First World War to conduct massive attacks with poison gas at Ypres in April 1915, which cemented Germany's image as an enemy who disregarded the rules of warfare among civilised nations.³² Colonial French troops from Algeria and Morocco were among the victims of the first poison gas attack on the Western front.³³ Some South African soldiers also experienced the effects of gas on the European battlefields.³⁴ English language colonial newspapers on the African continent informed their readers about the gas attacks, connecting chemical warfare to the brutality of a degenerated German *Kultur*.³⁵

Poison gas was associated with perceptions of an unprecedentedly vicious weapon. As pointed out by Marion Girard, the elusive quality of poison gas extends to its accurate definition: '...chemical weapons can be perplexing to identify; what people call poison gas does not have to be poison, nor must it be gas'.³⁶ The nature and effects of poison gases did not only perturb contemporary witnesses but has also led recent scholarship to condemn them as 'the most diabolical products of the mobilization of science'.³⁷ The different types of chemical warfare agents were by definition devious. Gas clung to clothing for some considerable time after a gas attack, and it stayed behind in abandoned trenches to assault the careless invaders and it could cause horrific deformation of the skin and temporary blindness.³⁸ Gases can be mixed in cocktails that produce multiple effects, e.g. to compel soldiers to get rid of their masks first to induce the inhalation of more lethal substances afterwards.³⁹ Even if non-lethal, the experience of chemical attacks could cause 'gas shock' comparable to the combat fatigue then described

as ‘shell shock’ that resulted from prolonged artillery and mortar fire.⁴⁰ ‘Its power to wound psychologically’ was noticed in the trenches and has been commented on by scholarly observers.⁴¹

Britain initially rejected the development of poison gas in 1914 but agreed to the use of irritants, such as tear gas in hand grenades, as an option left open by the Convention. After the German gas offensive at Ypres, however, Sir John French called for the development of lethal gases that could be dropped by aeroplanes and delivered by artillery.⁴² Britain’s own use of chemical weapons in the Great War was justified as a measured response to Germany’s breaches of civilised conduct.⁴³

Popular opinion in post-war Britain was fired by a vigorous anti-war mood.⁴⁴ A broad consensus on the immorality of chemical weapons seeped into the Western public domain in the interwar period, despite some ‘gas-tolerant’ observers who insisted that the defensive and offensive uses of chemical weapons were quite manageable.⁴⁵ The proponents of chemical weapons argued that gas had become an inevitable feature of modern warfare. One of the early theorists of aerial warfare, Giulio Douhet, reasoned that the use of chemical and biological weapons was a natural corollary of air power.⁴⁶ Douhet predicted that weapons of mass destruction were instrumental in breaking the will of the enemy population. The emphasis was not merely on physical destruction but on the psychological aspects of terrorising whole populations.⁴⁷ The military writer Basil Liddell Hart claimed in 1925 that ‘gas may well prove the salvation of civilisation’ because the dreadfulness of chemical weapons constituted a potent deterrent for any power to start another world war.⁴⁸ Pirow’s colleague in the Fusion cabinet, Jan Smuts, seemed to have thought along similar lines when he claimed in an interview with American journalists in 1930 that another world war was unlikely but that future conflicts would be decided by ‘poison gases concentrated in sweeping attacks on civilian populations’.⁴⁹

It was the frightening versatility and evasiveness of chemical weapons that placed tear gas too on the list of shunned chemical weapons after 1918. Far from being only useful as a relatively harmless irritant for crowd control, the Great War had shown that tear gas in highly concentrated doses could be used to daze the enemy into near paralysis in order to soften him up for an ensuing massive attack.⁵⁰ Britain and most other participants at the Washington Disarmament Conference (1921–22), which inserted a clause on the ban of poisonous gases in war,⁵¹ agreed therefore that it was technically impractical to ban chemical weapons on the basis of differentiating between lethal and non-lethal gases.⁵²

The 1925 Conference for the Supervision of the International Traffic in Arms and Ammunition at Geneva saw the first post-war attempt to arrive at an international agreement on limitations of chemical weapons. The protocol emerging from the conference referred only to the relations between states, however, and left sufficient leeway for the use of chemical weapons in domestic or colonial revolts. British military commanders and officials in the War Office clamoured for the use of chemical weapons against ‘savages’.⁵³ The Rif Wars in North Africa saw the French and the Spanish using gas weapons in the 1920s.⁵⁴ The Geneva Protocol was signed in 1925 and became operative in 1928, banning the use of chemical weapons but not their production and stockpiling. 38 countries, including the UK and South Africa, finally became signatories to the convention, excluding the USA and Japan.⁵⁵ There were no binding rules for the verification of the conditions of the agreement. Some of the signatories declared that they would respect the agreement only as long as other belligerents in a conflict would honour it. Beyond formulating an international consensus on the depravity of chemical weapons, the 1925

Geneva Conference and the League of Nations Disarmament Conference ten years later did not produce a mandatory mechanism to translate ethical repugnance into political action.⁵⁶

After the war, British governments were concerned not to be seen as violating the sensitivities of the public at home by stooping to methods that were branded as unnecessarily cruel. London regarded the 1925 Geneva Protocol as binding, although this provoked dissent from the War Office and the India Office at the CID. As early as in 1920, the War Office and the General Staff emphasised that chemical weapons were needed for the control of indigenous resistance to British rule.⁵⁷ A request for tear gas from the governor of Southern Rhodesia to deal with an African rebellion was rejected in 1926.⁵⁸ Despite these occasional scruples, the division between ‘civilised’ and ‘uncivilised’ societies considerably reduced moral restraints when the use of gas against indigenous communities was discussed.⁵⁹ Debates about the justified use of ‘civilized toxins’ against indigenous peoples continued in Britain as well as in the USA.⁶⁰ The British government of Punjab was one of ‘the first colonial outposts to lobby for access to tear gas’.⁶¹ At the time this request was still viewed by London with suspicion, but doubts seemed to have waned from 1926, when the Madras police submitted a similar request.⁶² In his study of tear gas doctrine in British India, Simeon Shoul argues that from the mid-1930s, ‘the proscription on tear gas gradually loosened’.⁶³ Even though the concern about colonial unrest made imperial decision-makers more amenable to the use of tear gas, it was not before 1939 that it was actually deployed in Burma.⁶⁴ The use of tear gas was not, however, always clearly separated from lethal methods in military thinking. The former Director of Experiments at Porton Down insisted that tear gas should always be used as a substitute for lethal gas and not, as suggested by some observers, as a means of driving indigenous insurgents out into the open ‘to be dealt with by rifle and machine gun fire’.⁶⁵

In the international arena, the Union signalled that it was in line with endeavours to control chemical and bacteriological weapons. Five years after Pirow raised the issue in London for the first time, South Africa’s representative at the League of Nations voted in favour of a resolution in the Assembly that called for the abstention from such weapons in war and from intentional bombing of civilians.⁶⁶

The real or imagined prospect of African protest also may have discouraged Pirow from advertising a gas production programme. From a white South African perspective, the chief purpose of the defence forces was to guarantee the safety of the white minority.⁶⁷ During the First World War, the military authorities had been very sensitive to reports and rumours about African unrest.⁶⁸ These anxieties about African discontent in various parts of the country continued to linger in the post-war period.⁶⁹ In the House of Assembly Pirow hinted at the efficiency of air power and the closely associated use of gas as the appropriate means to make white supremacy safe: ‘New inventions, tanks, armoured planes, and especially tear gas had brought them to a stage – and this was the ultimate test not only of humanity but also of efficiency – when any form of internal disorder could be suppressed with little or no bloodshed’.⁷⁰ Pirow had shown a ruthless determination in employing the controversial weapon of tear gas in his previous capacity as Minister of Justice. He initiated, despite the ambivalent image of chemical weapons, the first-time use of tear gas in South Africa against black protesters in Durban in 1929, at a time when the British cabinet still refused to permit the use of tear gas in Palestine⁷¹ and a year before Britain finally ratified the Geneva protocol.⁷² The South African nationalist media celebrated the humiliating effects of the Durban raid on blacks, reminiscent of Erik Linstrum’s emphasis on the spectacular and theatrical aspects of attacking protesting crowds in a colonial setting.⁷³ In a discussion about the use of tear gas in Nigeria in 1930, a member of the colonial administration explicitly referred to Pirow by saying that ‘if

you may use gas on a Hottentot why not on an Ibo'.⁷⁴ In 1935 Pirow offered the North Rhodesian government supplies of tear gas bombs for combatting striking African mine workers.⁷⁵

Pirow's concern about the development and modernisation of South African military efficiency, especially his interest in upgrading South African civil and military aviation, was occasionally formulated in a wider continental context.⁷⁶ Pirow was one of the most ardent proponents of a vaguely defined South African expansionism that claimed a pre-ordained role for the Union as a guarantor of white supremacy on the continent. Nebulous as this goal was, these aspirations were occasionally articulated by South African politicians of various ilk. Hertzog eyed the neighbouring territories Bechuanaland, Swaziland and Basutoland for incorporation into the Union. In his second meeting with Hitler in Berchtesgaden on 24 November 1938, Pirow declared that he viewed Tanganyika as belonging to the influence sphere of the Afrikaners because they were 'the leading exponents of white hegemony'.⁷⁷ Smuts also pursued a grand vision of a 'Greater South Africa' and frequently pronounced on the destiny of the Union as the guardian of a 'white civilisation' extending far beyond the borders of the Union.⁷⁸

Robert McCormack showed that Pirow's attempts to wrestle control of imperial aviation routes out of British hands were closely linked not only to white republicanism but also to his ambition of increasing South African influence northwards. Pirow's 'eclectic political philosophy which contained a curious amalgam of racialist, nationalist and imperialist ideas' worried British observers, especially when he started buying German airplanes.⁷⁹ It will be recalled that Pirow valued Junkers aircraft because they could be easily converted for carrying explosive and gas bombs.⁸⁰ As British aviation officials noticed, Pirow was driven by a desire to secure a hegemonic place for South Africa on the continent by improving communication among whites across southern, central and east Africa, thereby securing 'a considerable area in advance of its own frontiers as a precautionary defence measure'.⁸¹ Modern transportation and military technology were essential for the consolidation of a common white identity in the face of looming African resistance,⁸² even though other colonial governments were reluctant to welcome South African sub-imperialist aspirations.⁸³ Pirow's plan of getting hold of chemical weapons may have to be seen in the context of his vigorously promoted 'Union air imperialism'.⁸⁴

The white South African public was reasonably well informed of the debates about chemical weapons during the interwar period. The Italo-Ethiopian War, the Spanish Civil War and the Japanese penetration of China generated news stories and rumours about the use of poison gas in the 1930s. British 'gas-tolerant' experts like J.B.S. Haldane and Victor Lefebure⁸⁵ were sporadically mentioned in newspapers.⁸⁶ Occasionally, local chemistry professors presented lectures to educate the public on the horrors of gas warfare and the odd pacifist reader's letter expressed abhorrence of chemical weapons.⁸⁷ A.S. Neill, the unorthodox Scottish educator and founder of the famous Summerhill School, argued in a talk presented at the Rand Women's Club that 'the only things we have brought to civilisation are poison gas and armaments'.⁸⁸ Anxieties about gas warfare also percolated into black communities as may be deduced from a scam organised by an African fraudster and his white accomplice who told township residents 'that on a certain day poison gas clouds would be released over South Africa and only those people who would purchase gas masks and special uniforms from him would survive'.⁸⁹ It may be doubted, however, that the South African public responded by spending much thought on how these trends impacted on the specific security needs of their country beyond basic defensive precautions or on the question of whether or not South Africa should develop its own

offensive chemical weapons strategy. While there were plenty of opinion pieces that mulled over the anticipated horrors which the next war might bring, many of these contributions did not single out poison gas but covered the full gamut of modern weapons technology, predictably with a heavy emphasis on aerial bombing.⁹⁰ When a breakdown of international relations began to look more imminent in the late 1930s, anxiety levels palpably rose but did not necessarily focus on chemical warfare. Air raid precaution (ARP) and civil defence measures were implemented rather hesitantly, to the dismay of some members of the public.⁹¹ When drills took place in urban centres, they did not always involve anti-gas measures.⁹² While some observers criticised the government for neglecting to provide any protection against gas attacks,⁹³ there was no dearth of voices arguing that it was very unlikely that South Africa would be exposed to attacks with chemical weapons.⁹⁴ Pirow himself stated in the South African parliament in September 1938 that he did not anticipate any such attacks.⁹⁵ The first South African chemical warfare unit was founded only after the outbreak of hostilities in Europe.⁹⁶ Nearly two years after the war had started, the regional commandant of the Civil Protection Services (CPS) for the Witwatersrand lamented the ‘complete indifference to air raid precautions’ among the majority of South Africans.⁹⁷

Apart from the generally sensitive nature of chemical weapons research and development that made it advisable to tread with utmost caution and to avoid irritating public discussions of the ethical aspects, there were other domestic reasons for Pirow not to be seen as the organiser of a chemical weapons programme, especially not in close collaboration with the British. Pirow’s exposed position as a minister in the Fusion government provided another strong incentive to keep the envisaged project secret. Pirow constantly had to face charges by D.F. Malan’s National Party that he was a lackey of British imperialism. When Pirow was invited to a discussion of imperial defence matters in London in 1936 this unleashed ferocious accusations of selling out to the arch-enemy of Afrikanerdom and of betraying the neutrality of the Union by associating its security interests with those of the British Empire.⁹⁸ If Pirow’s appeals for British assistance in establishing a chemical weapons programme on South African soil would have become public, this could only have increased the opposition’s shrill attacks on his alleged hidden agenda as well as on prime minister Hertzog’s more subdued brand of South African republicanism. The only reference to a South African interest in acquiring poison gas that Pirow ever made in public, not without professing his ‘aversion’ to chemical weapons, carefully avoided mentioning his protracted attempts to obtain British backing and hinted at the possibility of producing gas as an entirely self-sufficient South African project.⁹⁹

What finally stopped Pirow’s efforts was, ironically, that South Africa and Britain moved closer together when the Second World War started. The tense stand-off within the South African coalition government between prime minister Hertzog and his deputy Smuts saw the pro-Empire faction in the South African parliament win the day on 5 September 1939. With Smuts being installed for the second time in his career as prime minister the Union joined the Allied war effort against Nazi Germany. This also meant that Pirow was expelled by the new government, to start his boisterous journey into extreme right-wing sectarianism which extended into the post-war period.¹⁰⁰ As discussions among officials in the Ministry of Air and Ministry of Supply from November 1939 show, his departure from office did not immediately remove British reservations about a South African chemical weapons programme. Early in 1939, the War Office had rejected the idea of providing the Union with any logistical support while Pirow was still the Minister of Defence.¹⁰¹ A hand-written note in the same file sceptically inquired ‘why they want it’ and ‘what they propose to use it for when they have made it’.¹⁰² An additional note also betrays suspicions regarding South Africa’s intentions listing the following reasons: ‘1. We do not particularly want South Africa to know officially

that we are making 'H' [mustard gas]. 2. We do not want the secret of 'H' to be universally known'. Moreover, the note expressed concerns about the loyalty of the Union since it 'contains such a large anti-British element'.¹⁰³ The war removed these reservations.¹⁰⁴ From summer 1940 the British were stepping up their efforts to increase their arsenal of poison gas. Richard Overy has noted that from 1941 'the RAF was primed to conduct a gas war against the German homeland'.¹⁰⁵ Far removed from the theatres of war, South Africa now looked like the perfect location for the manufacturing of chemical weapons for the British and their allies.

The gas factories in South Africa in the Second World War

The outbreak of the Second World War shifted the rationale of the production of chemical weapons from the underlying white fears of African unrest, which had been so clearly voiced by Pirow, to British anxieties about the unknown German capacities relating to chemical warfare. On 3 September 1939, the day of the British declaration of war against Germany, the British representative in Berlin was instructed to ask the German government whether they were prepared to respect the 1925 Geneva Protocol prohibiting the use of chemical weapons.¹⁰⁶ The Swiss envoy in London, representing German interests in Berlin, reported ten days later that the Germans promised to pursue a no-first-use policy.¹⁰⁷ Despite these assurances, recurring rumours about German progress in the development of novel chemical weapons continued to be nervously noted by London and Pretoria throughout the war and may have encouraged intermittent spurts of intensification of the gas programme.¹⁰⁸

From the start, the South Africans indicated that they wanted to produce mustard gas for their own purposes, i.e. 'on a scale sufficient for the possible requirements of Union Forces', initially planning for a capacity of 30 tons of mustard gas per month.¹⁰⁹ Continuously displaying a marked interest in pursuing the project, the South Africans pushed their British counterparts to proceed from 1940. Doubts about allowing the South Africans to gain access to the technology remained. The motivations for holding chemical weapons of their own were never clearly spelled out by the South Africans, which irritated British experts. 'The South African Government does not know exactly for what purpose 'H' in any form would be used. Their idea was to have the technique established thro' the erection of a small plant', was one exasperated comment.¹¹⁰ A report from 1943 explicitly stated that the South Africans insisted on having chemical weapons factories in the face of the initial 'reluctance of the U.K. Government to locate a war gas factory in the Union'.¹¹¹ Despite these open questions, however, the Union was eventually permitted to retain some chemical weapons at its own expense.¹¹² In June 1940, Major-General Pierre van Ryneveld approved of the general work structure developed by Hoare, who had been sent by Pirow to Britain six years earlier on the same mission and was now promoted to the rank of Brigadier-General.¹¹³ The African Explosives Company under the guidance of Kenneth Bingham Quinan made their premises at Modderfontein on the East Rand available.¹¹⁴ The American chemical engineer became a central figure in the gas production programme. The West Point graduate had worked for fifteen years in dynamite production in California before he arrived in Cape Town in 1899, a few months before the South African War started, accompanied by five American engineers. He became the general manager of the De Beers Cape Explosives Company manufacturing site at Somerset West, at the time the largest explosives production site in the world.¹¹⁵ This was a project initiated by Cecil Rhodes who wanted to circumvent the Nobel dynamite monopoly.¹¹⁶ Quinan was seconded by the company to supervise and manage a number of explosives plants in Britain from 1915. He became a member of the British Chemical Warfare Committee, and he played a major role in the organisation of mustard gas production in Britain by 1917.¹¹⁷ His

contribution to the British war effort earned him the highest praise from the British government.¹¹⁸

‘The best advice obtainable locally’ was made available for the project.¹¹⁹ Captain William Bleloch of the Union Defence Force, who had a doctorate in chemical engineering and had conducted research at the University of the Witwatersrand, became the general manager of the gas factory at Modderfontein before it was relocated to nearby Klipfontein, and the Firgrove facility near Somerset West. Klipfontein and Firgrove were designed to produce mustard gas. Apparently Klipfontein also had the capacity to manufacture phosgene gas, but it is not quite clear whether this actually happened.¹²⁰ The Firgrove facility was the domain of the British and to be financed entirely by London, while the Union carried fifty per cent of the costs of the larger Klipfontein factory.¹²¹ A considerable number of scientists and engineers were to join the project over the next couple of years.¹²² The Klipfontein camp could accommodate 400 white and 400 black workers, although these numbers dwindled again by 1943.¹²³ Both manufacturing sites were reported to have a total of 1894 employees, including chemists, engineers, typists, and workers.¹²⁴

Smuts was no stranger to the military opportunities offered by chemical weapons. He took a great interest in the chemical weapons factories and visited the Klipfontein production facility at least once.¹²⁵ In his capacity as the commander of the South African campaign in German East Africa during the First World War, he had requested the War Committee in London to send him gas supplies together with the requisite staff of experts.¹²⁶

In the last week of September 1940, the installation of the plant was reported to be finished.¹²⁷ Bleloch enumerated the wide range of delivery methods by which the gas could be deployed, from spraying from aircraft and aerial bombs to gas mines and mortar shells.¹²⁸ The extensive correspondence between South Africa and Britain reflects continuous discussions about the scientific and technical aspects of the production process. Samples of gas weapons were sent to Porton Down for inspection. The British experts frequently expressed criticism of the expertise of the South African personnel.¹²⁹ These anxieties ranged from leaking gas containers to general storage safety and environmental pollution.¹³⁰ The negligent handling of highly dangerous warfare agents made British observers ‘view the whole situation with alarm and despondency’.¹³¹ Recurring complaints about disturbing casualty rates among black and white workers referred to serious eye injuries, such as conjunctivitis and keratitis that were caused by a lack of protection against toxic vapours. If untreated these inflammations of the eyes can lead to permanent damage to sight. The same source also records a large number of arm injuries that were probably due to working without protective gear. There also were concerns that the handling of poisonous substances could have an impact on the mental health of staff members, but plans to ‘investigate histories of psychoneurosis at initial examinations’ foundered on the lack of resources.¹³² One of the British engineers seconded to South Africa observed that the production process had ‘never been satisfactory’.¹³³ He also commented that the South African system of racial segregation undermined the efficiency of the production of chemical weapons. Since jobs that were believed too menial for whites had to be performed by African workers, whom he considered to be insufficiently trained, the various stages of producing the gas and charging the bombs and drums did not always run as smoothly as expected. A visit at the Firgrove plant had taught him that ‘it is not permitted to ask a European to perform any work which a native either can do or has been accustomed to do’.¹³⁴ Concerns also focused on storage safety. Poison gas designed for shipping to Allied belligerents was stockpiled in Port Elizabeth. A British inspector noted that ‘the site is approximately 80 acres situated to the North of Port

Elizabeth. Assuming phosgene is ultimately stored here the site appears undesirably near a Native location – approximately $\frac{3}{4}$ mile to the South'.¹³⁵

The output of various types of mustard gas was increased from 30 tons to 80 tons and an increase of up to 250 tons per month was considered to be feasible.¹³⁶ At the end of 1944, the capacity of the Klipfontein plant was rated at 300 tons per month.¹³⁷ In 1942, it was decided to have the gas plants run by a civilian management that was monitored by a board, although the 'experimental stations', as they were sometimes called, remained under the supervision of the South African military. The board consisted of representatives of the South African military, the local mining industry, South African and British scientists, with Quinan acting in his capacity as a representative of the British Ministry of Supply.¹³⁸

The collaboration with Porton Down linked South Africa to an international network that the British had established from the First World War.¹³⁹ British scientists had been in touch with American experts since 1918. In the late 1920s Porton founded the Chemical Warfare Research Establishment in Rawalpindi in the Punjab and established links with the Australian Chemical Warfare Board.¹⁴⁰ Early in 1942, the British government in India showed interest in the developments in South Africa.¹⁴¹ After a visit to the Union the British Chemical Warfare Liaison Mission described South Africa's chemical weapons programme as suitable for replication in India, subject to conditions.¹⁴² The sources consulted do not provide any information on whether this suggestion was translated into reality.

The South Africans also collaborated closely with their counterparts in the United States. The idea of calling in American experts was suggested from June 1942.¹⁴³ During the first half of 1943, an unknown number of American chemical warfare specialists inspected the chemical weapons factories.¹⁴⁴ Apparently there also were plans to export poison gas to the United States.¹⁴⁵ Like their British colleagues, the Americans raised a number of critical concerns about the programme. They suggested that the South African expertise in running the gas factories remained unsatisfactory and could benefit from closer on-site collaboration with American experts.¹⁴⁶

Technical problems, such as unsafe storage of charged bombs, were also reported by Australia. Australia had ordered chemical weapons from South Africa, but representatives from the British Ministry of Supply complained about 'many design and technique hitches'.¹⁴⁷ The High Commissioner of Australia protested *via* London about the inferior quality and shoddy delivery of chemical weapons. The Australians had ordered 500 bombs from South Africa but were shocked to discover on arrival that the bombs were in a general state of corrosion and were not sufficiently secured for shipping. Australia cancelled any further deliveries.¹⁴⁸

Until the last stage of the war, the discussions about the quantity of output oscillated between the options of reducing or increasing the production of chemical weapons.¹⁴⁹ The continuous reports and rumours on the development of novel and increasingly dangerous chemical weapons by the Germans are sure to have influenced these discussions.¹⁵⁰ A sense of urgency seems to have been temporarily diminished by 1943 in the face of Germany's abstention from using chemical weapons although fears about the capacity of the Germans for gas warfare did not entirely subside.¹⁵¹ In July 1944 the Ministry of Supply informed the South Africans that the Klipfontein plant could be wound up, but that the Firgrove facility should continue. But it was not only the German peril that motivated the continuation of the gas programme. With a view to the ongoing war in Asia the British Ministry of Supply requested the continuation of the production of gases at Firgrove until at least October 1944, because 'while the prospect of

gas warfare in Europe is receding, the position in the East is still indefinite, and of course the S.A. plants are situated specially [sic] suitable for any Eastern developments'.¹⁵² This was in line with American requests to preserve British stocks of chemical warfare agents until Japan was finally defeated.¹⁵³ The termination of the production of gas did not therefore imply yet that the existing stock could be destroyed because the Allies had to be prepared for any eventuality and be ready 'to commence [production] without delay, if gas warfare occurs'.¹⁵⁴

The end of the South African chemical weapons programme

In a haphazard way, the two gas factories wound up their operations towards the end of the war. The main reason for the termination of the chemical weapons programme was rooted in the hefty financial burden that the upkeep of the programme would have implied now that Britain was no longer prepared to carry a share of the expenditure. In the light of the criticism of the technical problems that British experts had continuously expressed, the South Africans also may have worried about the negative impact of losing essential British expertise. The Firgrove facility was, however, assessed as unsuitable for the production of industrial or agricultural chemicals and discussions concentrated on Klipfontein.¹⁵⁵ Initially, Prime Minister Smuts requested that Klipfontein must be 'retained for a minimum period of 5 years after the war as a Government owned and Government controlled 'shadow' factory, available for the emergency production of the special war chemicals for which it was designed'.¹⁵⁶ This suggestion implied that concurrent with a clandestine military programme the factory could run a commercial production line of manufacturing pesticides. This would have considerably increased expenditure because 'the secret processes in the Factory could be revived in emergency only by experienced and skilled personnel, therefore as many of the present staff as possible must be retained'.¹⁵⁷ In order to cover up the true purpose of the factory the Secretary for Agriculture and Forestry suggested that it could be administrated from his ministerial portfolio.¹⁵⁸ When it became clear, however, that Britain had decided to withdraw from any further cooperation, Smuts and Quinan argued in favour of at least preserving the capacity for the production of agricultural chemicals such as DDT.¹⁵⁹ Sustaining the Klipfontein factory, now that Britain no longer saw the necessity of supporting the chemical weapons programme, proved to be a challenge for the Union. The Board estimated that £540, 000 would be needed to keep the factory permanently operative.¹⁶⁰ There were projections, however, that the conversion to a commercially viable enterprise could mark the beginning of a profitable 'self-supporting electro-chemical industry' in South Africa.¹⁶¹

As mentioned at the beginning of this article, from May 1946 the remaining stock of poison gas was dumped into the sea, not exceeding 'a distance of 40 miles from the quayside'.¹⁶² Apart from resurfaced containers causing injuries among fishermen, an even more dramatic accident had occurred more than a year earlier when the Grand Magazine in Pretoria exploded on 1 March 1945. Thirty-four workers died in the explosion.¹⁶³ The precise circumstances and consequences are difficult to extract from the consulted sources, but the files in the South African military archives state unequivocally that chemical weapons were stored in the Pretoria magazine. The ensuing investigation which started on the day of the explosion reported that there were '9000 rounds mustard gas shells of which 3000 [were] unexploded'.¹⁶⁴ The South African Army Engineer Corps was called in to decontaminate 'the mustard gas area',¹⁶⁵ and it was noted with relief that 'so far no gas casualties have been reported'.¹⁶⁶ To the insiders discussing the future of the chemical weapons programme, this incident can only have served as a reminder of the risks involved.

Conclusion

All the great powers since the First World War considered the use of chemical weapons and were involved in their production, although the use of gas remained a highly ambiguous choice in political terms. Many decision makers professed to accept its application mainly for retaliatory purposes since every side was assumed to possess gas weapons and could not be relied upon to abstain from using it as a last resort.

This article has argued that the South African interest in acquiring chemical weapons did not follow a master plan that was based on a defined policy of the defensive and offensive applications of gas but that this interest was inspired by a 'just-in-case' attitude that reverberated with concerns about consolidating the power of the white minority in the Union and beyond. In a colonial setting, the perennial anxieties about making white supremacy secure made chemical weapons an attractive option. Pirow expressed his interest in poison gas from the beginning of the 1930s, at a time when South Africa did not face any serious external threats. He vigorously launched his initiative before the Second World War shifted the emphasis from the black population as a potential target to the threat posed by Nazi Germany to the Allies. His frequent references to a 'black peril' against which white South Africans might have to defend themselves with gas reverberate with Coleman's verdict that '...chemical weapons are likely to be militarily attractive only in strongly unequal conflicts'.¹⁶⁷ When chemical weapons were eventually produced in the Union, British observers remained mystified why the South Africans were so keen to acquire chemical weapons for themselves. In the interwar period most military experts, in contrast to civilian observers, did not invest exaggerated expectations in the destructive potential of chemical weapons. A chemical attack was perceived to have dubious strategic value since it was mainly expected to kill unprotected civilians. In the debates about the ethics of poison gas both the detractors and the advocates of chemical weapons focused on their use against civilians. Each camp came to a different conclusion. The detractors argued that gas should be banned because it could be expected to be used against civilians. The advocates of chemical weapons replied that gas should not be banned because the prospect of its use against civilians would deter any power to use it or, if used at all, it would cut wars short.

In the South African context where fears of the black majority always suffused white politics, the vulnerability of black civilians to poison gas was hardly viewed as a strategic disadvantage. It is to these anxieties that the secret 'Project Coast' in the final years of the apartheid regime returned by exploring the use of bio-chemical weapons against black South Africans. From 1979, discussions among political and military leaders about the use of chemical and biological weapons shifted from its envisaged application in the Angolan war to their possible use in domestic 'counter-insurgency, assassinations, and black population control'.¹⁶⁸ Part of 'Project Coast' involved genetic engineering research with the objective of developing a 'black bomb' that would kill or incapacitate only black people but not whites.¹⁶⁹ Helen Burgess and Stephen Purkitt have pointed out that South Africa's involvement with chemical weapons during the war was important in allowing the country to keep pace with international scientific developments. The dumping of sulphur mustard supplies after the Second World War did not stop South Africa from maintaining a 'modest' chemical and biological weapons programme which resulted in experimenting with more sophisticated weapons of mass destruction during the apartheid period, always with an eye on ensuring the survival of white South Africa.¹⁷⁰

Notes on contributors

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Notes

1 'D.D.T. For Public Sale on Monday', *Rand Daily Mail*, 25 Jan.1946, 4. The production of chemical weapons was a strictly guarded secret in the Union of South Africa. In 1944, a brief newspaper article reported on the production of DDT in a 'state owned factory' [Klipfontein], without hinting at all that the facility actually produced mustard gas, 'State Controlled Factory Producing "Complete" Insecticide', *Rand Daily Mail*, 3 August 1944, 3. This article motivated the board of management to express their dismay as the chemical weapons programme had been placed on 'the most secret list' of military activities, [Department of Defence Documentation Centre South Africa], hereafter DoD, C[hief of the] G[eneral] S[taff] War, box 16, 6/1, vol 2, Chairman, Board of Management, C.D. Factories to Dr. Peter Allen, Secretary for Public Health, 3 Aug. 1944.

2 'State DDT Factory Made War Gases', *Rand Daily Mail*, 19 Feb.1946, 9.

3 'Ship Dumps 600 Tons Of Gas Shells', *Rand Daily Mail*, 11 June 1946, 5.

4 'Trawlers Nets Cans of Mustard Gas', *Rand Daily Mail*, 6 July 1946, 7; *ibid.*, 'Fishermen Net More War Gas', 9 July 1946, 5; *ibid.*, 'Mustard Gas Victims Still in Hospital', 15 July 1946, 5.

5 'Poison Gas Dumping; Official Blackout Follows Inquiry', *Rand Daily Mail*, 23 Aug. 1946, 4. See also Abel Esterhuysen, 'Chemiese Wapens in Suid-Afrika: Die Gifgasfabrieke by Klipfontein en Firgrove, 1940 – 1945', *Historia*, xlviii, no. 1 (2003), 241–2. Esterhuysen's article constitutes the only study of the South African gas factories, but it is entirely based on the documents in the South African military archives, does not cover the period before 1940 and only touches in passing on some aspects of international collaboration.

6 'All Poison Gas in Union Destroyed', *Rand Daily Mail*, 9 Sep. 1946, 5.

7 Ian van der Waag, *A Military History of Modern South Africa* (Johannesburg and Cape Town: Jonathan Ball, 2015), 193–95.

8 Oswald Pirow has been largely remembered for his pro-fascist propaganda and his attempts to revive his sagging career in the guise of a radical Afrikaner nationalist after he was ushered out of his ministerial post when Jan Smuts returned to the premiership to lead South Africa into the war as an ally of the British Empire from 1939. The first biography of Pirow has been published only recently to paint a fuller picture of the maverick politician. F.A. Mouton shows that Pirow enjoyed a considerable reputation as an efficient minister in two portfolios. Before the career of this mercurial and ubiquitous showman foundered on the rocks of South African party politics he was lauded for his energy and drive and even hailed by some observers in and outside the Union as the future prime minister of South Africa, despite his many character flaws. See F.A. Mouton, *The Opportunist. The Political Life of Oswald Pirow, 1915-1959* (Pretoria: Protea Book House, 2020), 74–5, 86.

9 Apart from holding the Defence portfolio, Pirow also was Minister of Railways and Harbours in the coalition government of J.B.M Hertzog's National Party (NP) and Smuts's South African Party (SAP) in 1933. The two parties merged into the United Party (UP) to form the so-called Fusion Government in 1934 with Hertzog as prime minister until 1939.

10 Committee of Imperial Defence. Minutes of the 259th meeting. 24 July, 1933, 2. [The National Archives, Kew, UK], hereafter TNA, [AIR] Ministry 2/1191.

11 The British committee members present at the meeting were: Chair, Stanley Baldwin; Secretary of State for the Dominions, J.H. Thomas; Secretary of State for War, Viscount Hailsham; Director of Military Operations and Intelligence, W.H. Bartholomew; First Sea Lord, Admiral A. Ernle M. Chatfield; Air Vice-Marshal Edgar R. Ludlow-Hewitt; Permanent Under-Secretary of State for the Colonies, Sir Samuel Wilson; Secretary, CID, M.P.A. Hankey; and officers E.J. Hodson; C.C.A. Allen, H.R. Pownall. Apart from Pirow, Chief of the South African General Staff Pierre van Ryneveld and High Commissioner for the Union in London, Charles Te Water were the other South Africans present.

12 Committee of Imperial Defence. Minutes of the 259th meeting. 24 July, 1933, 2, AIR 2/1191.

13 Committee of Imperial Defence. Minutes of the 259th meeting. 24 July, 1933, 6, AIR 2/1191. The founder of the liberal school of South African historiography, William Miller Macmillan, concluded after a meeting with Pirow in 1931 that Pirow's approach to race relations was to provoke blacks into open resistance in order to justify a violent response, F.A. Mouton, *The Opportunist. The Political Life of Oswald Pirow, 1915-1959* (Pretoria: Protea Book House, 2020), 46–7.

14 See Tony Emmett, *Popular Resistance and the Roots of Nationalism in Namibia, 1915–1966* (Basel: P. Schlettwein Publishing, 1999), 111–24.

15 Kessler, General Consulate Pretoria, 'Flugverkehr in der Union' [flight traffic in the Union], to AA, Berlin, 26 Dec. 1931. [Political Archives of the German Foreign Office, (PAGFO), Berlin], [A]uswärtiges [A]mt, Länderabteilung III, R 77576.

16 Kessler, General Consulate Pretoria to AA, Berlin, 26 Dec. 1931, AA, R 77576.

17 Minutes of the 259th meeting. 24 July, 1933, 7, AIR 2/1191.

18 Sir Harry Batterbee to Sir Christopher Bullock, 11 Oct. 1934, [includes letter from Stanley, High Commission South Africa] recording a conversation between Pirow and Liesching], Extract of letter from Sir H.J. Stanley, 19 Sep. 1934, AIR 2/1191.

19 Batterbee to Bullock, 11 Oct. 1934, AIR 2/1191.

20 Ibid. Pirow's comments also pointed at the history of the close involvement of universities in the development of chemical warfare. Estimates hold that about 5, 500 university-based scientists contributed to the research and production of poison gas during the First World War, Anna Feigenbaum, *Tear Gas. From the Battlefields of World War I to the Streets of Today*, Kindle edition (London: Verso, 2017), location 319.

21 Colonel [Hoare?], for Director of Air and Technical Services to Chief of the General Staff, 6 Oct. 1937. The report carries the stamp 'Seen by Minister 8.12.1937', i.e. Pirow, CGS War, box 16, 6/1, vol 1.

22 G.B. Carter, 'The chemical and biological defence establishment, Porton Down 1916–1991', *The RUSI Journal*, CXXXVI, no.3 (1991), 66–74.

23 Michael Freemantle, *The Chemists' War. 1914 – 1918* (Cambridge: Royal Society of Chemistry, 2014), 219; L.F. Haber, *The Poisonous Cloud. Chemical Warfare in the First World War* (Oxford: Clarendon Press, 1986), 204.

24 On the effects of sulphur mustard see also U.S. Department of Health & Human Services, USA.gov, Centres for Disease Control and Prevention, 'Facts about Sulfur Mustard', (2018), <https://emergency.cdc.gov/agent/sulfurmustard/basics/facts.asp> [accessed 5 Nov. 2020]

25 High Commissioner in South Africa to Secretary of State Dominion Affairs, 23 July 1937, TNA, Ministry of Aviation [AVIA], 2/1972.

26 T. Dederling, 'South Africa and the Italo-Ethiopian War, 1935-1936', *International History Review*, xxxv, no.5 (2013), 1009–30; Van der Waag, *Military History*, 167.

27 Extract from despatch from the High Commissioner for South Africa to the Secretary of State for Dominion Affairs, No.410, 26 Nov. 1935, AVIA 2/1879.

28 Mouton, *The Opportunist*, 69–70. Even if Pirow's frequent incantations of the 'black peril' were not without tactical motivations, his deeply engrained racism was, however, an enduring feature in his oscillating political career. See *ibid.*, 39–40, 46–7.

29 The 'askaris' that Pirow mentioned were not necessarily foreign invaders. Since the South African troops under Smuts had become acquainted with the military efficiency of African soldiers in the East African campaign in the First World War, the term was associated with any African skilled in handling a weapon, including the auxiliaries of friendly nations. The term continued to be used in the Second World War. For example, 'British askaris' are mentioned in: 'K.A.R. [King's African Rifles] Advance into Abyssinia', *Rand Daily Mail*, 2 August 1940, 15. 'Askari' acquired a new meaning in South Africa from the 1990s and referred to hit squads that consisted of defected or turned members of the black liberation movements who were trained to assassinate anti-apartheid activists. See Philip Phalane, '26 years into SA's democracy, a different type of Askari is emerging', *IOL News*, 7 Sept. 2020. [Accessed 19 March 2021].

30 For example: 'Black Troops from Tripoli. Mussolini's Rumoured Enlistment Aim', *Cape Times*, 6 September 1935, 12. See also Dederling, 'South Africa', 1020.

31 Ulf Schmidt, *Secret Science. A Century of Poison Warfare and Human Experiments* (Oxford: Oxford University Press, 2015), 15.

32 Kim Coleman, *A History of Chemical Warfare* (Houndmills, Basingstoke: Palgrave Macmillan, 2005), 18; Richard M. Price, *The Chemical Weapons Taboo* (Ithaca and London: Cornell University Press, 1997), 19–24.

33 F.J. Brown, *Chemical Warfare. A Study in Restraints* (Westport, Connecticut: Greenwood Press, 1968), 3.

34 For example, Sir Henry Lukin, the commanding officer of the South African 9th Division, Bill Nasson, *Springboks on the Somme. South Africa in the Great War, 1914-1918* (Johannesburg: Penguin, 2007), 142.

35 For example: *Rhodesia Herald*, 'Use of Asphyxiating Gases', 30 April 1915, 21; *Mafeking Mail*, 'Gas-Users Given Lesson', 29 April 1915; *Beira Post*, 'Plucky Canadians', 30 April 1915, 3; *East African Standard*, 'Criminal Use of Poisoned Bombs', 1 May 1915, 3; *Bulawayo Chronicle*, "'Huns" Gas and Bomb Attacks Repulsed', 5 May 1916, 9; *Uganda Herald*, 'New Trench Horror', 9 March 1917, 9.

36 Marion Girard, *A Strange and Formidable Weapon. British Responses to World War I Poison Gas* (Lincoln and London: University of Nebraska Press, 2008), 17. Although commonly called gas, mustard

gas is a chemical warfare vesicant (blister agent). A liquid substance, it attacks the lungs and skin with a fine mist.

37 Michael Adas, *Machines as the Measure of Men. Science, Technology, and Ideologies of Western Dominance*, Kindle edition, 1st edition 1990 (Ithaca and London: Cornell University Press, 2015), location 8865.

38 P. Thompson, 'The Chemical Subject: Phenomenology and German Encounters with the Gas Mask in the World War I', *History and Technology*, xxxiii, no.3 (2017), 258.

39 Girard, *Formidable Weapon*, 18–19.

Ibid, 18–22; Haber, *Poisonous Cloud*, 225.

40 Schmidt, *Secret Science*, 22.

41 T. Cook, 'Against God-Inspired Conscience': The Perception of Gas Warfare as a Weapon of Mass Destruction, 1915–1939', *War & Society*, xviii, no.1 (2000), 51.

42 Price, *Taboo*, 52–4.

43 Alan Kramer argues that the British use of poison gas during the Somme battle in August 1916 'has been edited out of popular memory', Alan Kramer, *Dynamic of Destruction. Culture and Mass Killing in the First World War*, Kindle edition (Oxford: Oxford University Press, 2007), 213.

44 Richard Overly, *The Morbid Age. Britain and the Crisis of Civilization, 1919-1939* (London: Penguin, 2009), 219–64.

45 Girard, *Formidable Weapon*, 158–63. See also E. Linstrum, 'Domesticating Chemical Weapons: Tear Gas and the Militarization of Policing in the British Imperial World, 1919–1981', *Journal of Modern History*, xci, no. 2 (2019), 557–85, L. van Bergen, 'The Poison Gas Debate in the Inter-War Years', *Medicine, Conflict and Survival*, xxiv, no.3 (2008), 174–87.

46 Thomas Hippler, *Bombing the People. Giulio Douhet and the Foundations of Air-Power Strategy, 1884-1939* (New York: Cambridge University Press, 2013), 141.

47 P. S. Meilinger, 'The Historiography of Airpower: Theory and Doctrine', *Journal of Military History*, lxiv, no. (2000), 471–73. The first chief of the Royal Air Force, Hugh Trenchard, also endorsed a vaguely defined concept of 'morale bombing', which he claimed would sap the psychological strength especially of indigenous people, see P.S. Meilinger, 'Trenchard and "Morale Bombing": The Evolution of Royal Air Force Doctrine Before World War II', *Journal of Military History*, lx, no.2 (1996), 243–70.

48 Cited in A.C. Grayling, *War. An Enquiry* (New Haven and London: Yale University Press, 2017), 97.

49 'General Smuts in New York. Views on League of Nations', *Rand Daily Mail*, 2 Jan. 1930, 10.

50 Coleman, *Chemical Warfare*, 30.

51 Since this clause was connected to a provision on the use of submarines that was rejected by the French this ban was not fully ratified, Coleman, *Chemical Warfare*, 45.

52 Price, *Taboo*, 76–8, 95–6.

53 R. M. Douglas, ‘Did Britain Use Chemical Weapons in Mandatory Iraq?’, *Journal of Modern History*, lxxxi, no. 4 (2009), 871. The author argues that no chemical weapons were employed in Iraq after protracted debates about the practical challenges and potential political blowback. It is interesting to note, however, that these debates blurred the differences between lethal and non-lethal chemical weapons. The interservices Chemical Warfare Committee recommended the use of tear gas as a means to drive indigenous insurgents into the open in order to expose them to lethal attacks, *ibid*.

54 Rudibert Kunz, ‘“Con ayuda del más dañino de todos los gases”. Der Gaskrieg gegen die Rif-Kabylen in Spanisch-Marokko 1922-1927’ in Irntrud Wojak and Susanne Meinel (eds), *Völkermord und Kriegsverbrechen in der ersten Hälfte des 20. Jahrhunderts* (Frankfurt am Main: Campus, 2004), 153–91.

55 After prolonged debates Britain ratified the Protocol in 1930, E.M. Spiers, ‘Gas Disarmament in the 1920s: Hopes Confounded’, *Journal of Strategic Studies*, xxix, no.2 (2006), 295. South Africa deposited its intention to adhere to the Protocol in 1930, <http://disarmament.un.org/treaties/a/1925/southafrica/acc/paris>, United Nations Office for Disarmament Affairs [accessed 20 Nov. 2019].

56 Coleman, *Chemical Warfare*, 46; Price, *Taboo*, 72–8.

57 Spiers, ‘Gas Disarmament’, 285.

58 Edward M. Spiers, *Chemical Warfare* (Houndmills, Basingstoke: Palgrave, 1986), 48.

59 Feigenbaum, *Tear Gas*, location 335.

60 Feigenbaum, *Tear Gas*, location 335.

61 Feigenbaum, *Tear Gas*, location 703.

62 Feigenbaum, *Tear Gas*, location 721.

63 S. Shoul, ‘British Tear Gas Doctrine between the World Wars’, *War in History*, xv, no.2 (2008), 181. See also Simeon Shoul, ‘Soldiers, Riot Control, and Aid to the Civil Power in India, Egypt, and Palestine, 1919-1939’ (PhD dissertation, University of London, 2006).

64 Linstrum, ‘Domesticating Chemical Weapons’, 573.

65 Major P. Murphy, ‘Humane Uses of the Chemical Weapon’, *The Army, Navy & Air Force Gazette*, 7 March 1935, 187–88.

66 League of Nations. Reductions and Limitation of Armament and Protection of Civil Population against Bombing from the Air in Case of War, 1938, DoD, Secretary for Defence, [GP.] 2, box 2770, 982/3 vol.2.

67 See the British periodical *The Army, Navy & Air Force Gazette*, 13 Sep. 1928, 807. See also Van der Waag, *Military History*, 160.

68 See, for example, a report claiming that Africans constructed imitations of trenches and forts on the West Rand, in *Rand Daily Mail*, ‘Natives building “Forts”’. Mystery on the West Rand. Anxiety among White People’, 10 Dec. 1917, 6.

69 See reports for the period 1919 to 1927 in DoD, GP, D[eputy] C[hief of] S[taff]/CGS, box 40, CGS 373/1, Native Unrest. Healdtown; *ibid.*, Native Unrest. Port Elizabeth and General, GP. DCS/CGS, box 40, CGS 373/5, 1920 ; *ibid.*, Native Unrest. Natal, 1922-1926, GP. DCS/CGS, box 40, CGS 373/8.

70 Cited in *The Army, Navy & Air Force Gazette*, 24 May 1934, 410–11.

71 Linstrum, 'Domesticating Chemical Weapons', 570.

72 F.A. Mouton, "'Die slag van Durban": Die Massiewe Polisie-Optrede van November 1929 in Durban', *Kleio*, xxi, no.1 (1989), 47–57. Apart from the Bondelswart Rebellion mentioned earlier this was probably the other instance of South African experience with gas and bombs that he mentioned at the 1933 CID meeting. The use of tear gas against the Durban strikers was also noted with interest in British India in 1930, see Feigenbaum, *Tear Gas*, location 753. On the reasons for the greater acceptance of the use of tear gas by American police forces in the 1920s see D.P. Jones, 'From Military to Civilian Technology: The Introduction of Tear Gas for Civil Riot Control', *Technology and Culture*, xix, no.2 (1978), 151–68.

73 Linstrum, 'Domesticating Chemical Weapons', 562.

74 Feigenbaum, *Tear Gas*, location 853.

75 Ronald Hyam, *The Failure of South African Expansion, 1908-1948* (New York: Africana Publishing Corporation, 1972), 39.

76 On Pirow's initiatives see Van der Waag, *Military History*, 159–64; Bill Nasson, *South Africa at War, 1939-1945* (Johannesburg: Jacana Media, 2012), 31–40. See also G. Bentz, 'Fighting Springboks. C Company, Royal Natal Carbineers: From Premier Mine to Po Valley, 1939 – 1945' (MA dissertation, Stellenbosch University, 2013), 7–13.

77 Cited in Mouton, *The Opportunist*, 118.

78 See the seminal study by Ronald Hyam, *Failure of South African Expansion*.

79 R.L. McCormack, 'Man with a Mission: Oswald Pirow and South African Airways, 1933-1939', *Journal of African History*, xx, no.4 (1979), 544.

80 McCormack, 'Man with a Mission', 549.

81 Memorandum by the Director General of Civil Aviation, F.C.S. [Sykes], 2 April 1937, AVIA 2/2119. On Pirow's expansionist ideas against the complex background of South African-British-German relations see Albrecht Hagemann, *Südafrika und das "Dritte Reich". Rassenpolitische Affinität und machtpolitische Rivalität* (Frankfurt/Main: Campus, 1989), 172–203.

82 On Pirow's emphasis on the military value of consolidating an imperial air route see High Commissioner in South Africa to Secretary of State Dominion Office, 10 Nov. 1934, AVIA, 2/1911.

83 The Governor General of the Belgian Congo caustically referred to some soothing remarks made by Pirow to the press and stated that he was 'glad to learn...that South Africa was not casting eyes on the Colony', British Consulate-General, Leopoldville to His Majesty's Ambassador, Brussels, 1 Sep. 1937, AVIA 2/2119.

84 R. McCormack, 'Airlines and Empires: Great Britain and the "Scramble for Africa", 1919-1939', *Canadian Journal of African Studies*, X, no. 1 (1976), 97.

85 Girard, *Strange and Formidable Weapon*, 158–63.

86 For example, ‘Terrors of Gas and Explosives Exaggerated. Prof Haldane’s Views of War of Future’, *Rand Daily Mail*, 27 Oct. 1937, 17; ‘The Great Chaos – VI. Use of Poisoned Bullets and Gases. By H.R. Knickerbocker’, *ibid.*, 21 Aug. 1935, 3.

87 ‘Death from the Air. Poison Gas and Bacteria’, *Rand Daily Mail*, 14 Aug. 1930, 9; ‘Nature of New Warfare. Combat between the Chemists. Pretoria Professor’s Prophecy’, *ibid.*, 1 Sept. 1930, 4; ‘Chemistry and War. Future Horrors for Civilians’, 12 Nov. 1931, 9; ‘Chemical Warfare. How City could be Destroyed in Four Days. Rand Doctor’s Address’, *ibid.*, 21 March 1935, 7; ‘Next War Will Be a Massacre. Only Course is to Offer No Resistance’, *ibid.*, 7 July 1936, 17.

88 ‘Happy Parent is the Ideal’, *Rand Daily Mail*, 3 Aug. 1936, 11.

89 ‘Natives Say “Prince” Told Them to Buy Gas Masks’, *Rand Daily Mail*, 13 July 1940, 13. Con man Percy Kgobe added an interesting twist to the story by claiming ‘that the gas would be released by the Abyssinians’, ‘£10, 000 Fraud Allegations Against Natives’, *Rand Daily Mail*, 17 July 1940, 11.

90 For example, ‘What the Next War Will Be Like’, *Rand Daily Mail*, 15 March 1933, 11; ‘Warfare of the Future. Devastation from the Air’, 7 Dec. 1935, 9.

91 ‘Gas Mask and A.R.P. Placard at City Meeting’, *Rand Daily Mail*, 12 Oct. 1939, 12

92 ‘City Fire Brigade is Ready for Air Raids. Demonstrations of Latest Devices’, *Rand Daily Mail*, 23 May 1939, 5.

93 ‘S.A. Within Range of Air Attack’, *Rand Daily Mail*, 30 April 1937, 18.

94 ‘South Africa needs an A.R.P. System. – II. The Dangers of Air War’, *Rand Daily Mail*, 20 Feb. 1939, 4. The author, identified as ‘a military expert’, called for the urgent implementation of air raid precaution measures but he argued that aerial bombing and the shelling of coastal towns were far greater dangers to South Africa than gas attacks.

95 Van der Waag, *Military History*, 165.

96 ‘Chemical Warfare Company Formed’, *Rand Daily Mail*, 25 Nov. 1939, 13.

97 ‘Public Apathy Towards C.P.S. Dangerous’, *Rand Daily Mail*, 19 Aug. 1941, 9.

98 Mouton, *The Opportunist*, 78, 85.

99 ‘Large Scale Raid is All South Africa Need Fear – Mr Pirow. War Preparations Outlined’, *Rand Daily Mail*, 24 Jan. 1938, 3.

100 F.A. Mouton, “‘Fascist or opportunist?’” The political careers of Oswald Pirow, 1915-1943’, *Historia*, lxiii, no. 2 (2018), 93–111; Mouton, “‘Beyond the pale’”: Oswald Pirow, Sir Oswald Mosley, the “Enemies of the Soviet Union” and Apartheid, 1948-1959’, *Journal for Contemporary History*, xliiii, no. 2 (2018), 15–32.

101 C.S. Robinson, 30 Nov. 1939, AVIA, 22/1727.

102 Illegible signature, 18 Dec. 1939, AVIA, 22/1727.

- 103 Illegible signature, 30 Nov. 1939, AVIA, 22/1727.
- 104 F.C. Everett [Ministry of Supply, Assistant Director], 27 Sep. 1941, AVIA, 22/1727.
- 105 Richard Overy, *The Bombing War: Europe, 1939-1945*, Kindle edition (London, Penguin, 2013), 105–6.
- 106 Under-Secretary of State for Foreign Affairs to Under-Secretary of State for Home Affairs, 3 Sep. 1939, TNA, Home Affairs [HO], 186/2846.
- 107 Note from Swiss Legation, 8 Sept. 1939, HO, 186/2846.
- 108 A. Gascoigne, Foreign Office, forwarding letter from British Consulate-General, Tangier, 20 May 1942, HO, 186/2846; Atholl to Minister of Information, 15 July 1940, TNA, Ministry of Information [INF], 1/269; Admiralty to C-in-Cs of all major theatres, 8 May 1942, CGS War, box 16, 6/1, vol 1. The British secret service investigated the possibility of contaminating the seats of the Berlin Opera House with mustard gas before a Nazi rally, see Keith Jeffery, *MI6. The History of the Secret Intelligence Service, 1909 – 1949* (London and Berlin: Bloomsbury, 2010), 322.
- 109 Minute of a meeting, CGS office, 21 Jan. 1942, CGS War, box 16, 6/1, vol 1, (attached to Cable, DO, London, to Minister of External Affairs, Pretoria, 2 Jan. 1942).
- 110 C.S. Robinson, 16 Jan. 1940, AVIA, 22/1727.
- 111 Board of Management, C.D. Factories to Brigadier E. Williamson, 21 July 1943, CGS War, box 16, 6/1, vol 2.
- 112 Oppositely to Dechief, 5 Feb. 1942, CGS War, box 16, 6/1, vol 1.
- 113 Van Ryneveld, 20 June 1940, CGS War, box 16, 6/1, vol 1.
- 114 Hoare, 19 June 1940, CGS War, box 16, 6/1, vol 2.
- 115 Memo to General Savile, 27 Jan. 1915, TNA, Ministry of Munitions [MUN] 7/26.
- 116 Robert I. Rotberg (with the collaboration of Miles F. Shore), *The Founder. Cecil Rhodes and the Pursuit of Power* (Johannesburg: Southern Book Publishers, 1988), 641–42.
- 117 Haber, *Poisonous Cloud*, 125, 165–6.
- 118 T. Evans, ‘Keith Bingham Quinan: An Explosive Start’, *The Chemical Engineer*, May 2015, 36–41.
- 119 Hoare to Chief of General Staff, 7 June 1940, CGS War, 6/1, vol. 1, box 16.
- 120 Biggam, 12 July 1944, CGS War, box 16, 6/2, vol 2. Phosgene gas could be mixed with chlorine to create a potent lethal weapon, see Coleman, *Chemical Warfare*, 24.
- 121 ‘Future of the Chemical Defence Factories’, Report submitted by Board of Management to Chief of the South African General Staff, AVIA, 22/1735, 7 Sept. 1945.
- 122 Esterhuysen, ‘Chemiese Wapens’, 227.

- 123 W.G. Geach to Secretary of Defence, 18 Sep.1943, CGS War, box 17, 6/3, vol 2.
- 124 List attached to memo, 21 Jan. 1943, CGS War, box 16, 6/1, vol 2.
- 125 Biggam to H.W.A. Cooper, 24 July 1944, CGS War, box 17, 6/3, vol 4.
- 126 London explained, however, that it felt committed to a no-first-use policy and that there were a number of technical reasons that made the transport to and the use of gas in Africa inadvisable. The War Committee left the final decision to the South African general before Smuts desisted in view of the technical difficulties; War Office to Smuts, 30 Oct. 1916, TNA, Cabinet Minutes [CAB], 42/21/14.
- 127 W. Bleloch to Controller of Explosives & Chemical Research [Hoare], [Oct/Nov 1940], CGS War, box 16, 6/1, vol 1.
- 128 Bleloch to D.C.G.S. and D.F.E., 30 Oct.1940, CGS War, box 16, 6/1, vol. 1.
- 129 For example, Oppositely to Dechief, 5 Nov. 1940, CGS War, 6/1, box 16, vol. 1; Oppositely to Dechief, 18 Nov.1940, *ibid.*; Bleloch to Director General of Technical Services [DGTS] and CGS, 10 Feb.1941, *ibid.*; Oppositely to Dechief, 18 March 1941, *ibid.*
- 130 See the correspondence in AVIA 22/1731: Chemical defence in South Africa: DESA gas plant, 1940-1945. An extensive report prepared for Smuts explained that 'D.E.S. is the code name for pure diechlor-diethyl sulphide, the active principle in all types of mustard gas, and "A" was added to indicate manufacture in Africa', see Organisation for the Production of Chemical Warfare Agents, 10 Aug. 1944, CGS War, box 17, 6/3, vol 4.
- 131 W. Chiesman, to Hirst [Ministry of Supply], 26 Aug.1943, AVIA 22/1734.
- 132 Fortnightly Liaison Report: Number One. 1 May 43: Part Two,1 May 1943, CGS War, box 18, 6/5, vol 5 A.
- 133 Madel, M.S. [Ministry of Supply] Factory, Rhydymwyn, to Ministry of Supply, London, 7 Feb. 1944, AVIA 22/1733.
- 134 Madel, M.S. Factory, Rhydymwyn, to Ministry of Supply, London, 7 Feb. 1944, AVIA 22/1733.
- 135 R.J. Rosser, 15 November 1943, CGS War, box 18, 6/5, vol 2.
- 136 Dechief to Oppositely, 16 May 1941, CGS War, box 16, 6/1, vol. 1.
- 137 Office of General Manager, Klipfontein, to Chairman, Board of Management, 8 Dec.1944, AVIA 22/1731.
- 138 Memorandum for Defence Authorities Committee, Cape Town, [no day] March 1943, CGS War, box 16, 6/1, vol 2.
- 139 Carter and Pearson's study of Allied scientific cooperation mentions South Africa only in passing, see G. Carter and G. S. Pearson, 'North Atlantic Chemical and Biological Research Collaboration: 1916-1995', *Journal of Strategic Studies*, xix, no.2 (1996), 74-103.
- 140 Schmidt, *Secret Science*, 59-60.
- 141 DO, London, to Minister of External Affairs, Pretoria, 2 Jan.1942, CGS War, box 16, 6/1, vol 1.

- 142 H. Paget to General HQ, New Delhi, 25 June 1942, CGS War, box 16, 6/1, vol 1.
- 143 Dechief to Oppositely, 2 June 1942, CGS War, box 16, 6/1, vol 1; Report on Chemical Warfare Liaison Mission on Visit to the Union of South Africa May/June 1942, 9 June 1942, WO 188/820, 6.
- 144 Major Biggam to K.B. Quinan, 22 Dec. 1942, CGS War, box 16, 6/1, vol 1.; *ibid.*, Oppositely to Dechief, 8 Jan.1943.
- 145 This may be deduced from a note saying that US authorities cancelled an order of 600 tons in 1944, Dechief to Coastcom, 3 Jan. 1944, CGS War, box 16, 6/2, vol 2.
- 146 Dechief to Saleg Washington, 19 July 1943, CGS War, box 17, 6/3, vol 2; Memorandum for M.B. Chittick, 29 July 1943, *ibid.*
- 147 Dalton to Biggam, 6 July 1943, CGS War, box 18, 6/5, vol 2; *ibid.*, Dalton, Report on Position at End October, 1943.
- 148 [Illegible signature] for Dalton, Report on position at end of January 1944, CGS War, box 19, 6/5, vol 3; Oppositely to Dechief, 8 March 1944, *ibid.*
- 149 H.S. Hirst to Quinan via UK High Commission, 30 Jan.1943, CGS 16 6/1, vol 2; Quinan to Biggam, 2 June 1944, *ibid.*
- 150 For example: Memo, Gen. Stussy [?], Trends in Chemical Warfare, 14 Aug.1944, CGS 16 6/1, vol 2.
- 151 Hirst to Quinan via UK High Commission, 30 Jan. 1943, CGS 16 6/1, vol 2. By 1944 the Germans stored thousands of tons of gas, including the new nerve agents Sarin and Tabun. Churchill considered gas attacks on German rocket installations and even on urban centres. See Overy, *Bombing War*, 379–81.
- 152 S. Eadon [?] to Board, 12 Oct.1944, CGS, box 16, 6/1, vol 2.
- 153 Schmidt, *Secret Science*, 169.
- 154 S. Eadon [?] to Board, 12 Oct.1944, CGS, box 16, 6/1, vol 2.
- 155 ‘Future of the Chemical Defence Factories’, Report submitted by Board of Management to Chief of the South African General Staff, 7 Sept. 1945, AVIA, 22/1735.
- 156 Van Ryneveld to H.J. Van Eck, 6 Feb.1945, CGS, box 16, 6/1, vol 2; S. Eadon [?] to Board, 12 Oct.1944, *ibid.* A ‘shadow factory scheme’ was implemented in Britain to step up the rearmament programme in the late 1930s. Thus, motorcar manufacturers agreed to build government funded factories to produce aircraft and aero-engines. See Daniel Todman, *Britain’s War. Into Battle, 1937-1941* (New York: Oxford University Press, 2016), 96.
- 157 Van Ryneveld to H.J. van Eck, 6 Feb. 1945, CGS 16 6/1, vol 2.
- 158 P.R. Viljoen, Secretary for Agriculture and Forestry, to Secretary for Defence, 2 March 1945, CGS War, box 24, 6/19, Post War Defence Chemical Unit, 1945 – 1947.
- 159 Quinan to CGS, 11 Sep.1945, S. Eadon [?] to Board, 12 Oct.1944, CGS, box 16, 6/1, vol 2; R. Owens, Ministry of Supply, to Quinan, 16 May 1946, AVIA, 22/1735.

160 This sum would run up to £23,459,977.66 in today's terms; see *CPI Inflation Calculator*, £540,000 in 1945 → 2020 | UK Inflation Calculator (in2013dollars.com) [accessed 25 March 2021]

161 'Future of the Chemical Defence Factories', Report submitted by Board of Management to Chief of the South African General Staff, AVIA, 22/1735, 7 Sept. 1945.

162 Folder: Personal copy of second fortnightly report from A.D.S.D. (Chem. W.) UDF for period ending 15 May 1943 for Col. K.C.S. Layzell, [illegible signature], to GHQ, Pretoria, 20 March 1946, GP. 1 Deputy Chief of Staff/Chief of the General Staff, DCS/CGS, box 6.

163 Markgraaf to Campbell Ross, 2 March 1945, CGS War, box 48, 12/9, Grand Magazine Explosion, 1945.

164 Markgraaf to Campbell Ross, 1 March 1945, CGS War, box 48, 12/9, Grand Magazine Explosion, 1945.

165 DGTS, Pretoria, to CGS, 2 March 1945, CGS War, box 48, 12/9, Grand Magazine Explosion, 1945; *ibid.*, CGS to Smuts, 1 March 1945.

166 The *Rand Daily Mail* was among those South African newspapers that reported in detail about the explosion but, for obvious reasons, without mentioning chemical weapons. Immediately after the explosion 'families living in the vicinity' were evacuated, , '32 Killed, 83 Badly Hurt in Pretoria Explosion', *Rand Daily Mail*, 2 March 1945, 3. A British Pathé newsreel showing the aftermath of the explosion is accessible at <https://www.britishpathe.com/video/grand-magazine-explodes-s-africa/query/+PRETORIA> [accessed 20 Nov. 2019].

167 Coleman, *Chemical Warfare*, xxi.

168 Stephen F. Burgess and Helen E. Purkitt, *The Rollback of South Africa's Biological Warfare Program* (Colorado Springs: USAF Institute for National Security Studies, USAF Academy, (2001), 17.

169 Burgess and Purkitt, *Rollback*, 21.

170 H. E. Purkitt and S. Burgess, 'South Africa's Chemical and Biological Warfare Programme: A Historical and International Perspective', *Journal of Southern African Studies*, xxviii, no.2 (2002), 230–31. See also Helen E. Purkitt and Stephen F. Burgess, *South African Weapons of Mass Destruction* (Bloomington and Indianapolis: Indiana University Press, 2005), 30–31, C. Gould and P.I. Folb, 'The South African Chemical and Biological Warfare Program: An Overview', *The Nonproliferation Review*, vii, no.3 (2000), 10–23.