International Encyclopedia of the First World War

Version 1.0 | **Last updated 08 January 2017**

Science and Technology (Australia)

By Eric Endacott

Australia made a limited contribution to the fields of science and technology during the First World War. Notwithstanding limitations posed by Australia's great distance from the battlefront and her limited manufacturing capacity, Australians willingly employed their minds and bodies to further the Allied cause. The most practical contributions were made by individual servicemen, university staff, and chemists serving abroad.

Table of Contents

Introduction

Australians swiftly perceived that the successful prosecution of the First World War depended on science and technology. Australia, however, was poorly placed to figure prominently in scientific and technological innovation. Having only gained independence from Britain in 1901, Australia still functioned as a dutiful colony, playing its part in the imperial economy by supplying primary products

such as wool and wheat to Britain, and in turn Australia received manufactured goods.[1] Australia had minimal manufacturing capacity, and scientific research was in the hands of amateurs and staff members of the Australian university who were scattered across the continent. The capacity of Australians to engage in science, the systematic study of the physical and natural world, and technology, the practical application of scientific knowledge, was thus limited. Indeed, defining what constituted an "Australian" during this period is both contentious and elusive, due to the predominantly British immigrant population and overlapping national identities that existed between Australia and Britain during this period. For the purposes of this paper, persons will be considered to be Australian if they identified as such, were resident within Australia for a significant period of time, or were born in Australia.

Little academic research has been undertaken relating to this area because historians have typically perceived the shortcomings of Australian science and technology during the First World War as the springboard which led toward the future of Australian manufacturing and scientific research.[2] The chief sources that are relevant to the period are Ernest Scott's official history of the homefront, a compilation of the activities of the Australian Department of Defence until June 1917, and an unpublished history of Australian defence production.[3] Australia quite arguably had little to offer to the Allied war effort, yet the few resources available were unhesitatingly dedicated to this cause. The Australian government willingly served as the conduit between Australians engaged in scientific and technological efforts and the British government. This article will explore the role played by Australians in science and technology during the First World War by examining the interactions between the Australian government and the military, and organised science and technology and civilians.

The Australian Government and the Military

The Australian military was responsible for the most practical scientific and technological innovations originating from Australia during the Great War. These inventions were not the product of scientists in laboratories but rather were the ideas of soldiers. Unlike France, Great Britain, Germany or the USA, Australia never created specialist research departments.[4] The lack of formal research institutions in no way inhibited the unsolicited inventiveness of individual Australian military personnel.

Australian servicemen sought both defensive and combative solutions to their wartime problems. These were typically simple in nature, born out of the needs they encountered on the battlefront, and created with the materials that they had at hand. Among the earliest successful inventions was a periscope enabling troops to observe and shoot from within the safe confines of a trench. Developed at Gallipoli by Lance Corporal William Beech (1878-1929), a makeshift factory on the beach was soon producing them en masse.[5] To disguise the final evacuation of troops from Gallipoli, a number of methods were developed to trigger rifles to fire after troops had abandoned them in the trenches. Lance Corporal William Scurry (1895-1963) invented one of the simplest, allowing water to slowly

drip into a tin, which upon overbalancing, fired the rifle.[6] It has been noted, however, that these so-called "drip rifles" made no contribution to the success of the evacuation.[7] Lieutenant Andrew Varley (1890-1951) was one of very few Australians whose inventions were formally adopted by the British authorities. His mortar-fired smoke bomb, which was used to conceal attacking troops, was officially adopted after being championed by General John Monash (1865-1931).[8]

Australian military personnel appear to have taken a special interest in technological innovation. Such was the quantity of inventions submitted to the British war authorities from Australian servicemen that the War Office sanctioned the establishment of an Australian Imperial Force Inventions Research Section with its own experimental ground.[9] In the words of its Australian commander in charge of this section, Lieutenant William Geake (1880-1944), "valuable suggestions made by the A.I.F. forces averaged two to one as against the suggestions from all other sources."[10] The research section gathered together Australians with inventive leanings who, like Geake, had failed to have their own inventions adopted.[11] For example, Corporal Alexander Muirhead (1848-1920) had invented a device for reloading Lewis machine-guns, but upon submission found that another inventor had beaten him to it. Instead, he was invited by the Invention Research Section to solve the problem of machine-guns jamming through shrinkage of ammunition belts. Within two weeks Muirhead produced a single-use paper version of the belt, which was promptly adopted.[12]

The Australian government owned the majority of factories responsible for the manufacture of military technology and equipment. Four factories were in existence at the start of the war: Lithgow small arms factory, Maribyrnong explosives (cordite) factory, South Melbourne clothing factory and the harness, and the saddlery and leather accoutrements factory at Clifton Hill, Victoria.[13] Two additional factories, one creating the woollens and the other extracting acetone (for the production of cordite), were established during the war. The key cordite and small arms factories had barely opened when the war was declared. For instance, the sole factory capable of creating military rifles, the Lithgow Small Arms Factory, had produced a total of six rifles when war broke out.[14] Manufacturing sufficient rifles of adequate quality proved technologically challenging. The Small Arms Factory was able to create only 25 percent of rifles issued to Australian troops, whose training was often hampered due to a shortage of modern rifles.[15] Complaints about the quality of rifles, such as "tightness in the action", led to the unpopular placement of military inspectors within the factory.[16] Australia never manufactured artillery pieces, nor machine-guns, and made only a brief commercial attempt to manufacture artillery shells (discussed later in this article). Given the evident manufacturing challenges, exports were limited. Australia did, however, export small-arms ammunition to three other nations of the Commonwealth and supplied acetone to India for munition works.[17] Naval manufacture also continued during the war at the Cockatoo Island Dockyard in Sydney that built three destroyers and the light cruiser *Brisbane* during the war, and launched a second light cruiser, *Adelaide*, in July 1918.[18] A limited number of military airplanes were manufactured by private firms within Australia.[19]

The war highlighted the weak state of manufacturing within Australia. Despite being one of the world's largest wool exporters, Australia had to import nearly all woollen yarn for clothing, as only one Australian factory could create it. Similarly, clothing factories faced critical shortages of needles, which could not be readily replaced.[20] In late 1915, the British government asked Australia to increase local manufacturing so as to free up British manufacturing for the war effort.[21] This request, coupled with marketplace shortages, led to more than 400 new items being manufactured for the first time in Australia, ranging from typewriter ribbons and sheep dip to ether anaesthetic and batteries.[22]

Individual military personnel contributed useful scientific and technological innovations during the First World War, whereas the formal Australian government and military institutions contributed little in the fields of science and technology.

The Australian Government and Organised Science

The Australian government relied heavily on universities and manufacturers for advice on matters relating to science and technology during the First World War. This section will explore contributions relating the manufacture of munitions and the proposed arsenal, and contribution made by university staff members.

Munitions manufacture

The public furore in Britain in 1915 over the shortage of artillery shells resulted in civilian-initiated munitions manufacturing in Australia.[23] In a surge of patriotism associated with the landing at Gallipoli, the sinking of the Lusitania, the zeppelin raids and the use of poison gas at Ypres, Australian firms lobbied the national government for support in a shell-making venture.[24] Upon British acceptance of the scheme, private firms and state-government owned railway workshops commenced production, but encountered a series of technical challenges generated by inexperience, lack of specialist machinery and ever-changing specifications.[25] Indeed, one month before the first shell was successfully created, the British government advised that, due to expanded manufacturing in Britain, additional shells would not be required.[26] Perhaps reluctant to terminate an endeavour that had barely commenced, the Australian government was tardy in communicating this to manufacturers.[27] Eventually, 15,715 shells out of the proposed 290,830 were produced, and notwithstanding certain faults, were accepted by the British.[28] Attempts by a patriotic citizen committee to manufacture machine-guns were blocked by the government because of a lack of machinery and experienced workmen.[29] Another machine-gun manufacturing scheme at the Walsh Island Dockyards seems not to have achieved success.[30] The most useful contribution made by Australia to the munitions shortage was therefore the export of 17,900 tons of munitions-grade steel to Britain.[31]

The Arsenal Project and Australians in British War Industry

The stated desire of the Australian government to be self-sufficient led it to pursue the creation of an Australian arsenal to manufacture heavy artillery and munitions.[32] The experienced emissaries sent on fact-finding missions to England and India, however, swiftly questioned this efforts usefulness to the war effort. The necessary machinery was all in use in Britain; the highly trained labour required was fully employed; the construction of such a venture would take many years and a single centralized arsenal had failed in Britain.[33] The planned national arsenal was therefore abandoned. The emissaries had meanwhile identified other needs within Britain. Arthur Leighton (1873-1961), the man selected to lead the Arsenal project, identified the need for chemists, while Professor Samuel Barraclough (1871-1958) noted the need for skilled labour.[34]

Experienced chemical engineers were required to design and operate explosives factories in Britain within which the base materials of propellants and high explosives were created and then combined.[35] These roles called for significant innovation and research to develop efficient and safe chemical processes.[36] From late 1915, some 130 Australian chemists would be recruited over the course of the war, representing a significant scientific contribution to the total of 250 chemists employed in the British factories responsible for creating the explosives critical for the profligate use of artillery necessary for successful attacks.[37] These chemists were chiefly recruited from the mining and sugar industries, and from universities.[38]

A number of schemes enabled Australians to contribute to the wartime British manufacturing industry. From 1916 onwards, the Vickers company recruited almost 1,000 Australian men until an official governmental scheme was introduced.[39] The official Australian government scheme was unable to meet British requests for select trades in their entirety, but sent about 2,900 skilled tradesmen, including carpenters, fitters and turners, toolmakers and joiners, to work in British factories and for other military endeavours.[40] Women were not permitted to serve, perhaps in recognition of prevailing Australian values, but also due to express instructions received from Britain.[41] These workers represent a minor contribution when compared to the overall estimated 3 million munitions workers who were employed in Britain.[42]

University staff

University staff actively placed their expertise at the disposal of the war effort. At the University of Melbourne, three professors – David Masson (1858-1937), Thomas Laby (1880-1946) and William Osborne (1873-1967) – and postgraduate student Ernst Hartung (1893-1979), created a gas mask based on the "very vague" information publicly available through newspapers.[43] Crafted from materials such as tobacco tins, nose clips and motoring goggles, it was tested in a purpose-built trench on university grounds wherein it "was tried on as many of their friends as they could induce to

go into the trench."[44] Their design was accepted by the Commonwealth Government who agreed to manufacture 10,000 sets. Subsequent advice from the British War Office and a formal evaluation noting its inability to protect against the lachrymator group of poison gases, led to production being discontinued, although elements may have been incorporated into the later British box respirator.[45]

Individual university academics distinguished themselves abroad in their war service. William H. Bragg (1862-1942), former professor at Adelaide University, focussed on problems of submarine detection. His son, William L. Bragg (1890-1971), led a team designing a method of sound ranging to locate enemy artillery batteries.[46] This sound ranging method, acknowledged as superior to that employed by the Germans, was critical in the suppression of enemy artillery during the final Allied offensives of 1918.[47] Richard Threlfall (1861-1932), previously a Professor at the University of Sydney, was actively engaged in inventions and research work focussing on tracer ammunition and the use of phosphorus in smoke-screens.[48] Edgeworth David (1858-1934) led the mining corps; Professors Hubert Whitfeld (1875-1939) and Norman Wilsmore (1868-1940) worked with British munitions producers, Professor Barraclough led the Australian Munitions Workers; and physicist James Pollock (1865-1922) created a geotelephone for underground listening.[49]

The announcement of British plans for a national scientific and research organisation led to Australian academic and state leaders agitating to follow suit.[50] With the support of Prime Minister William Hughes (1862-1952), the Advisory Council on Science and Industry was duly created, but formalising the nature, funding and research aims became a drawn-out process with little being achieved during the war.[51] This organisation was the forerunner of the modern-day Commonwealth Scientific and Industrial Research Organization (CSIRO), thereby representing a valuable investment in the future.

The Australian Government and Civilians

Australian civilians recognised the central role of science and technology in the war effort. As South Australian John Watters noted in a letter to the Defence Department in September 1915, "this is a war in which trickerary [sic] and applyanceses [sic] plays a most important part."[52] Wartime saw a sudden surge in war inventions as civilians from all walks of life advocated the adoption of their ideas, suggestions and inventions (henceforth referred to as inventions). It would be remiss to deny the presence of "cranks" with "a kind of mania for inventing", whose fanciful inventions focused on the "perpetual-motion fetish", or in one instance, electric boots to protect soldiers from disease, worry, and "a pent up craving for the other sex."[53] The majority, however, were not the follies of an eccentric and non-representative group of Australians.[54] Inventions were predominantly received from men (97 percent), whose complex motives variously included patriotism, profit, anxiety for serving family members, hatred of the enemy, expressions of loyalty and guilt for not having enlisted.[55] Surges in inventing were closely associated with key events of the war and surges in

patriotism identified by First World War historians Adrian Gregory and John Connor.[56]

The contributions of amateur Australian inventors were closely associated with areas of perceived British weakness in science or technology. Inventors focused their efforts upon new weaponry such as aircraft, poison gas and submarines.[57] Inventions varied greatly in their complexity. At the lowest level, F. Anning suggested that, when defending against an attack, "round Hoops thrown out from our trenches would tangle them up." James Hanson "intimated that his idea consisted of tying explosives on to rabbits & chasing them into the enemies' trench."[58] In contrast, other inventors filled rooms with poisonous gas in order to test their gas mask designs and "came out allright [sic], and had not to be carried out."[59] Michael McGinness, a mining expert, created a working scale model of a mechanical catapult.[60] The need for grenades prompted particularly inventive effort. This image depicting grenade designs submitted by amateur Australian inventors (see image) demonstrates the variety and complexity of the designs involved. The Australian government manufactured 15,000 Welch-Berry grenades designed and tested in Australia, but these were rejected by the British War Office and appear never to have seen active service.[61]

The Defence Department dashed the hopes of most Australian inventors by evaluating their inventions as useless. This was not simple condescension. Australian civilians were far from the battlefront, possessed little military information, and generally lacked the technical capacity to bring their inventions to a functional level.[62] It was these conditions that caused many inventions to be deemed "wildly impracticable", "absolutely useless" and "obviously futile and the creations of an imagination unfettered by knowledge or experience."[63] The light-weight wooden cart designed by master craftsman Alexander Worsfold was the only invention successfully adopted, and only after he enlisted and demonstrated its efficacy in the field.[64] Australian inventors had greater success abroad. John Pomeroy (1873-1950), a New Zealand born engineer who had lived in Australia, received £25,000 from British authorities for the invention of an incendiary bullet.[65] Despite their best efforts, Australian civilian inventors contributed little of use in the fields of science and technology.

Conclusion

Australia was a small player in the field of science and technology during the First World War. This was not due to a lack of willing effort, but rather insuperable challenges including sheer distance from the battlefront, and a lack of manufacturing capacity caused in part by the legacy of the old imperial economy. The weaknesses highlighted during the First World War drove the post-war government enthusiasm for self-sufficiency, and the intentional development of science and technology within Australia.

Eric Endacott, Independent Scholar

Section Editor: Peter Stanley

Notes

1. ↑ Beaumont, Joan: Broken Nation. Australians in the Great War, Sydney 2013, p. 37.

2. ↑ Ross, Andrew: Armed & Ready. The Industrial Development & Defence of Australia, 1990-1945, Sydney 1995.

3. ↑ Scott, Ernest: Australia During the War, first published 1936, Brisbane 1989; Office of the Secretary: Report upon the Department of Defence For the period between 1 July 1914, and 30 June 1917, National Archives of Australia M349, VOLUME 1; Jensen, John: Defence production in Australia to 1941. A historical record, unpublished National Archives of Australia North Melbourne MP598.

4. ↑ Hartcup, Guy: The War of Invention. Scientific Developments, 1914-1918, London 1988, pp. 21-36.

5. ↑ Bean, Charles: The Story of ANZAC. From 4 May, 1915, to the Evacuation of the Gallipoli Peninsula, 11th ed., first published 1924, Sydney 1941, p. 251.

6. ↑ Bean, Story 1941, p. 883.

7. ↑ Stanley, Peter: Quinn's Post, Anzac, Gallipoli, 2005, p. 178.

8. ↑ Bean, Charles: The Australian Imperial Force in France, 1917. 11th ed., first published 1933, Sydney 1941, p. 718.

9. ↑ Scott, Australia 1989, p. 249.

10. ↑ Scott, Australia 1989, p. 249.

11. ↑ National Archives of Australia North Melbourne, MP367/1, 514/14/48.

12. ↑ Scott, Australia 1989, p. 250.

13. ↑ Ibid., p. 237.

14. ↑ Jensen, John: The Development of Munitions Production in Australia, Melbourne 1943, p. 4.

15. ↑ Office of the Secretary, Report, p. 248.

16. ↑ Scott, Australia 1989, p.261; Patmore, Greg: 'American Hustling Methods.' The Lithgow Small Arms Factory 1912-1922, in: Labour History 67 (1994), pp. 42-56, p. 51, http://www.jstor.org/stable/27509274 (retrieved: 22 August 2014); Office of the Secretary, Report, p. 323.

17. ↑ Office of the Secretary, Report, p.253, Scott, Australia 1989, pp. 260-261.

18. ↑ Jose, Arthur: The Royal Australian Navy, 1914-1918. 9th ed., first published 1928. Sydney 1941, p. 429, http://www.awm.gov.au/histories/first_world_war/AWMOHWW1/AIF/Vol9/ (retrieved: 22 August 2014).

19. ↑ Jensen, Defence, cited in Ross, Armed 1995, p. 31.

20. ↑ Office of the Secretary, Report, pp. 254-255.

21. ↑ Connor, John: The War Munitions Suppy Company of Western Australia and the Popular Movement to Manufacture Artillery Ammunition in the British Empire in the First World War, in: The Journal of Imperial and Commonwealth History 39/5 (2011), pp. 795-813, p. 806, http://www.tandfonline.com/doi/full/10.1080/03086534.2011.629087#tabModule (retrieved: 22 August 2014).

22. ↑ Scott, Australia 1989, p. 459.

23. ↑ Connor, War 2011, p. 797; Office of the Secretary, Report, p. 465.

24. ↑ Connor, War 2011, pp. 796-797.

25. ↑ Connor, War 2011, p.805; Office of the Secretary, Report, pp. 470-472; Scott, Australia 1989, p. 246.

26. ↑ Scott, Australia 1989, p. 245.

27. ↑ Connor, War 2011, p. 805.

28. ↑ Office of the Secretary, Report, pp. 469, 478-479.

29. ↑ Office of the Secretary, Report, p. 483.

30. ↑ Office of the Secretary, Report, p. 483.

31. ↑ Scott, Australia 1989, p. 248.

32. ↑ Scott, Australia 1989, p. 239.

33. ↑ Scott, Australia 1989, pp. 264-266; MacLeod, Roy: The "Arsenal" in the Strand. Australian Chemists and the British Munitions Effort 1916-1919, in: Annals of Science 46 (1989), pp. 45-67, p. 54.

34. ↑ Scott, Australia 1989, p. 265.

35. ↑ MacLeod, Arsenal 1989, p. 52.

36. ↑ Ibid., p. 61.

37. ↑ Ibid., p. 48.

38. ↑ Ibid., pp.57-61.

39. ↑ MacLeod, Roy: 'The industrial invasion of Britain'. Mobilizing Australian munitions workers, 1916-1919, in: Journal of the Australian War Memorial 27 (1995), pp. 37-46, p. 39.

40. ↑ Scott, Australia 1989, p. 267; MacLeod, Industrial 1995, pp. 39-41.

41. ↑ Jensen, Defence, unpublished, pp. 360-363, National Archives of Australia North Melbourne, MP598/30/15.

42. ↑ MacLeod, Arsenal 1989, p. 48.

43. ↑ Selleck, Richard: The Shop. The University of Melbourne 1850-1939, Melbourne 2003, pp. 564-565; Letter Orme Masson to Harold Whiteside, 5 July 1915, National Archives of Australia North Melbourne, A2023, B217/1/681.

44. ↑ Scott, Australia 1989, p. 253.

45. ↑ Dean, Katherine: Demonstrating the Melbourne University Respirator, in: Australian Journal of Politics and History 53/3 (2007), pp. 392-406, p. 400.

46. ↑ Hartcup, War 1988, pp. 71-75, 130-131.

47. ↑ MacLeod, Roy: Sight and Sound on the Western Front. Surveyors, Scientists and the 'Battlefield Laboratory', 1915-1918, in: War & Society 18/1 (2000), pp. 40-45.

48. ↑ Hartcup, War 1988, pp. 102, 160.

49. ↑ National Archives of Australia North Melbourne, B2455 3490152; Connor, War 2011, p.807; MacLeod, Industrial 1995, p.39; David, Tannant: Professor Pollocks War Service, in: Hermes, August (1922), pp. 80-84.

50. ↑ Currie, George/Graham, John: The Origins of CSIRO. Science and the Commonwealth Government 1901-1926, Melbourne 1966, pp. 13-29.

51. ↑ Currie/Graham, Orogins 1966, pp. 36- 76.

52. ↑ Letter J. Watters to Pearce, Minister for Defence 20 October 1915, National Archives of Australia North Melbourne, A2023, B217/1/879.

53. ↑ Letter R. Shreeve to Pearce, Minister for Defence 27 July 1916, National Archives of Australia North Melbourne, A2023, B217/3/495;Office of the Secretary, Report., p. 341; Letter J. Thomas to Pearce, Minister for Defence 20/8/15, National Archives of Australia North Melbourne, A2023, B217/1/1119.

54. ↑ Endacott, Eric: Inventing to Win the War. Amateur Inventors and the Australian Home Front, 1914-1918, unpublished Honours thesis, Deakin University 2012, pp. 9-25.

55. ↑ Ibid., pp. 16-25.

56. ↑ Gregory, Adrian: The Last Great War. British Society and the First World War. Cambridge 2008, pp. 39, 46; Connor: War, 2011, pp. 796-797.

57. ↑ Endacott, Inventing 2012, pp. 27-28.

58. ↑ Letter F. Anning to Minister for Defence 7 July 1915, National Archives of Australia North Melbourne, A2023, B217/3/2; Memorandum, National Archives of Australia North Melbourne, A2023, B217/3/293.

59. ↑ Argus, p.23, 23 November 1918, National Archives of Australia North Melbourne, MP 367/1, 514/1/205.

60. ↑ National Archives of Australia North Melbourne, B539, AIF132/1/2475.

61. ↑ Office of the Secretary, Report, p. 482.

62. ↑ Endacott, Inventing 2012, pp. 39-42.

63. ↑ Minute, Acting Chemical Adviser 8 January 1917, National Archives of Australia North Melbourne, A2023, B217/3/522; Report Major Purcell, Officer Commanding Remount Depot to Director of Remounts 23 November 1915, National Archives of Australia North Melbourne, A2023, B217/1/857; Minute Dangar, Chief of Ordnance 25 November 1914, National Archives of Australia North Melbourne, A2023, B217/1/78.

64. ↑ National Archives of Australia North Melbourne, A2023, B217/1/980; National Archives of Australia North Melbourne, B2455, 3444658; Australian War Memorial, C04780, online: http://www.awm.gov.au/collection/C04780/ http://www.awm.gov.au/collection/C04780/ (retrieved: 15 June 2014).

65. ↑ Hartcup, War 1988, p. 159.

Selected Bibliography

Connor, John S.: **The war munitions supply company of western Australia and the popular movement to manufacture artillery ammunition in the British Empire in the First World War**, in: The Journal of Imperial and Commonwealth History 39/5, 2011, pp. 795-813.

Dean, Katrina: **Demonstrating the Melbourne University respirator**, in: Australian Journal of Politics & History 53/3, 2007, pp. 392-406.

Endacott, Eric: **Inventing to win the war. Amateur inventors and the Australian home front, 1914-1918 (thesis)**, Melbourne 2012: Deakin University.

MacLeod, Roy: **The 'Arsenal' in the strand. Australian chemists and the British munitions effort 1916-1919**, in: Annals of Science 46/1, 1989, pp. 45-67.

MacLeod, Roy: **Sight and sound on the Western Front. Surveyors, scientists, and the 'battlefield laboratory', 1915-1918**, in: War & Society 18/1, 2000, pp. 23-46, **doi:10.1179/072924700791201405**.

MacLeod, Roy: **'The industrial invasion of Britain'. Mobilizing Australian munitions workers, 1916-1919**, in: Journal of the Australian War Memorial 27, 1995, pp. 37-46.

Ross, A. T.: **Armed and ready. The industrial development and defence of Australia, 1900-1945**, Wahroonga 1995: Turton & Armstrong.

Scott, Ernest: **Official history of Australia in the war of 1914–1918. Australia during the war, volume 11**, St. Lucia 1936: University of Queensland Press.

Citation

License