

Le déluge: Aluminium in the age of global conflict

In this second instalment looking at the development of the global aluminium industry, **Dr Andrew Perchard*** explores the effects of the global conflict on the industry between the outbreak of WWI, in 1914, and the height of the Cold War in 1962.

In 1915, Britain's Minister of Munitions David Lloyd George referred to the conflict raging since 1914, as a 'deluge... bringing unheard-of changes in the social and industrial fabric'. Lloyd George, who subsequently became Prime Minister of a new wartime coalition in December 1916, was acutely aware of the pressure that the new industrialised warfare had placed on an economy ill-suited to meeting such demand, and of the need for a reformed war economy. Formerly Chancellor of the Exchequer (1908-1915), Lloyd George had been appointed Minister of Munitions, on the back of the Shells Crisis of May 1915, overseeing the redirection of Britain's wartime industrial capacity to meet the war effort, including for vital raw materials. Between 1914 and 1918, military spending in all of the three main belligerent powers – Britain, France and Germany (the United States did not enter the War until 1917) – remained above 50% of GDP. World War One (WWI) transformed the market for global aluminium and the relationships between national producers and governments.

Shortages in, and the rising cost of, other non-ferrous metals (particularly copper) as well as technological innovations, during WWI created a substantial demand for aluminium. Global consumption of the metal almost trebled from 66,000 metric tons (mts) to 196,000mts between 1913 and 1918. Uses for the metal (in virgin ingot, alloy and powder form), which had started off being used primarily for field canteens, in explosives, and to replace copper wiring,

expanded as its adaptability, lightness, as well as innovations in military technology and warfare developed. Increasingly aluminium became associated with the growth in aerial warfare (initially for aero-engines and dirigibles), with military aircraft production in Britain alone increasing from 245 machines in 1914 to 32,018 by 1918, and aero-engines from 99 to 22,088 over the same period. This had been aided by German metallurgist Alfred Wilm's pre-war invention and patenting of Duralmin (an alloy of aluminium, copper, manganese, and magnesium). By 1915, Hugo Junkers had designed and built the first all-metal aircraft, the Junkers J-1 (**Fig 1**).

Even Imperial Germany, the economy

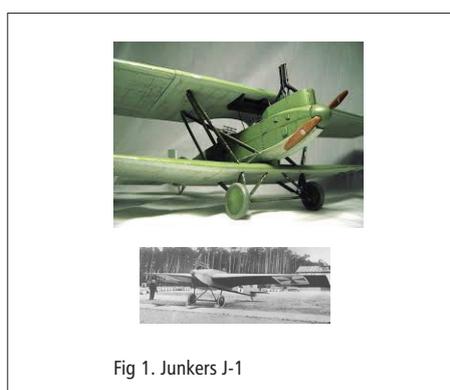


Fig 1. Junkers J-1

best organised and equipped to meet the demands of modern warfare, was quickly put under pressure as it became clear this was to be a war of attrition rather than a swift campaign. It was Germany's

depletion of its scant remaining matériel, as well as the ghastly toll in human life, which eventually brought it to its knees in 1918. Whilst Britain, in particular, was slow to adapt to a modern war economy, it is important to underline that the scale and nature of the war on the Western and Eastern Fronts was unprecedented. Britain's ability to transform to a war economy and prosecute economic warfare, and draw on Empire arms and resources and American finance, were crucial to preventing it from collapse. At the outbreak of war, Britain relied almost exclusively on the output of the aluminium reduction works of the British Aluminium Company (BACo) in the Scottish Highlands (producing 92% of Britain's aluminium), with some smaller quantities from the Aluminium Corporation's Dolgarrog plant in Wales and BACo's Vgjelands Brug in Norway. The advance of the German army by 1915 reduced BACo's access to bauxite supplies from its southern French subsidiaries. Instead it was forced to re-open its inferior bauxite deposits at Larne in Ireland. Britain's supply issues were further compounded by the fact that it was also acting for much of the war as the armoury for the Entente Powers. This included aluminium, which it was also supplying to Imperial Russia (prior to October 1917). By 1915, Britain had become dependent on aluminium from the Northern Aluminium Company of Canada (subsequently the Aluminium Company of Canada (Alcan), owned at the time by US firm Alcoa. This created tension between Britain and the US (a

As Dr Dewey Anderson, director of Washington think tank, the US Public Affairs Committee, remarked in 1951: 'Aluminium has become the most important single bulk material of modern warfare. No fighting is possible, and no war can be carried to a successful conclusion today, without using and destroying large quantities of aluminium.'

*Senior Research Fellow at the Centre for Business in Society, Coventry University (UK), and co-founder and director of the History and Strategic Raw Materials Initiative

neutral power before 1917), with the British Government increasingly inflamed by Alcoa's exponential raising of the export prices for aluminium ingot from an Empire source and their perceived war profiteering. For Imperial Germany, cut off from its main Swiss (but German owned) supplier AIAG Neuhausen by 1915, the increasing effectiveness of blockades after 1916, and supply shortages was the midwife of innovation to create substitutes. It also gave birth to a new industry player, *Vereinigte Aluminium Werke AG* (VAW) (in 1917), and the building of four new smelters in Germany between 1915 and 1917. Even France (one of the few national aluminium producers with plentiful access to domestic bauxite) struggled because of the pressures on the supply chain.

As aluminium gained in strategic importance, it consequently transformed the relationship between the aluminium industry and the state in the main combatant nations. In Britain, France, and Germany, the industry leaders were co-opted into government service. In the longer term, this afforded British, French and German aluminium industry leaders political and financial support for the expansion of the industry. British and French industry leaders also saw the opportunity to seize control of lucrative post-war central European markets through the support of the seizure of AIAG's plants, held by the French authorities as enemy assets, and by attempting a failed attempt to seize directorships on the Swiss company's board.

After the signing of the Armistice in 1918, the global industry leaders from the Entente powers, Louis Marlio of France's Alais, Froges et Camargue (AFC), BACo's Andrew Tait, and Alcoa's Arthur Vining Davis met to carve up the post-war market for aluminium; Alcoa taking North America, and AFC and BACo, central European markets and the British Empire. Whilst the immediate post-war period presented challenges for the global industry, with an immediate fall in demand and stockpiles of ingot and scrap metal dumped onto world markets, the war increased the visibility, and understanding of the applications, of aluminium. Alcoa and its Canadian subsidiary had expanded their markets, especially with an end to imports for the duration of the war, and their smelting capacity. Despite the 1918 agreements with BACo, Alcoa's Davis saw an opportunity for Northern to exploit British imperial markets. However, this was hampered by lingering suspicion of Alcoa, after wartime price rises, until 1928 when Northern (by now Alcan) was legally separated from Alcoa in response

to US anti-trust actions against the parent company. Competition within European markets was also increased by the wartime creation of the VAW. After global tensions in the industry between 1918 and 1923, the industry experienced a period of



Fig 2. Graf Zeppelin bombing Warsaw (1914)

relative peace with the establishment of the Aluminium Association in 1926 (excluding Alcoa and Northern because of the ongoing US anti-trust action). As well as setting sales quotas and price, this cartel's functions also included advertising, R&D, and logistics. This was replaced by the Alliance Aluminium Company in 1931, including Alcoa and Alcan. It is important to note that cartels were far more common in this period governing about 40% of world trade by the late 1930s, and that they were generally condoned by many national governments.

Peace in the aluminium industry,

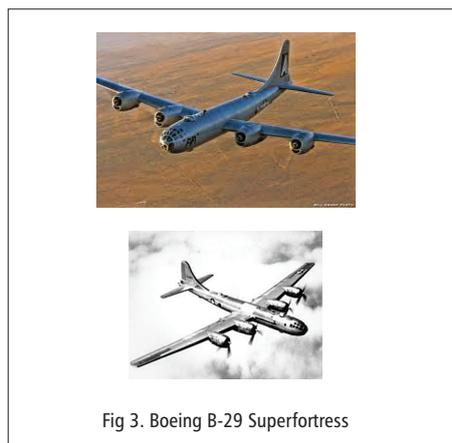


Fig 3. Boeing B-29 Superfortress

as in wider society, was ruptured by rearmament and the outbreak of the Second World War (WWII) in 1939. Aluminium became even more crucial as a strategic metal. Between 1939 and 1944 alone, global aluminium consumption rose from 677,400mts (almost double that of 1936) to 1,468,000mts, while production increased from 720,000mts

to 1,690,000mts. Much of this went to meet the exponential growth in aircraft production. Nazi Germany constructed 111,767 between 1934 and 1944, and Britain 123,819 between 1934 and 1945. Between 1940 and 1945, the United States built 300,000 military (or associated) aircraft (such as the Boeing Superfortress, **Fig 3**) and the Soviet Union around 136,800 during WWII.

Nazi Germany dramatically increased aluminium production and amassed. Between 1934 and 1939, German output of aluminium grew from 30,000mts to 200,000mts. From being completely reliant on AIAG for aluminium before 1915, Germany had become the largest single global producer of the metal by 1939 (accounting for 30% of global output). Increasingly, after 1939, most aluminium, like magnesium, was consumed by the *Luftwaffe*. Part of the attraction to the Nazis of invading Norway, for example, lay in its production of aluminium, magnesium, molybdenum, and nickel. Most of France's aluminium output, though largely based within the Vichy zone, was given over to the Nazi war effort. Similarly, as with oil, rubber, tin and nickel, so too Imperial Japan seized the bauxite reserves within Malaya and the Dutch East Indies.

On the eve of the Battle of Britain (July-October 1940), Britain was facing a shortage in aluminium supplies, essential to building aircraft like the Spitfire (**Fig 4**), which was a mainstay of the Royal Air Force's Fighter Command. Despite, the addition of the Lochaber smelter to the roster of BACo's Highland smelters, their Norwegian plants had been seized by Nazi Germany in June 1940, and demand for aluminium had quickly outstripped domestic supplies. From 1941 until 1943, Britain relied heavily on costly (both in shipping losses and investment) imports of Canadian aluminium to meet its requirements; if Detroit, and the US more broadly, fast became known as the 'arsenal of democracy' then Canada became the 'arsenal of empire'.

For many of the belligerent powers, aside from the US and Canada, secondary aluminium recovered from scrap became increasingly important. But it was in North America where the largest growth in the global industry occurred. Largely unhindered by enemy air attack, and with considerable financial and political support from government on both sides of the 49th parallel (and in Canada's case from the British government), the US and Canadian aluminium industries expanded production capacity dramatically. For Alcoa though, the war and antitrust sentiment, led to the creation of two major (and a number of smaller) competitors,

the Reynolds Metals Company and Kaiser Aluminium. Strong political (and financial) support was crucial to Reynolds and Kaiser's entry, survival and success in a US market previously monopolised by Alcoa. Between 1944 and 1946, Reynolds Metals increased their share of US aluminium production from 7% to 30%, and Kaiser from 2% to 20%. Both would go on to become significant global players.

The expansion of aluminium production to meet wartime demands also profoundly affected technological innovation within the industry and increased the race to identify new reserves of bauxite. Whilst the dropping of the nuclear bombs on Hiroshima and Nagasaki – and the subsequent development of nuclear strike capabilities by the Soviet Union, Britain and France – decreased the emphasis on large conventional forces in the longer term, aluminium remained crucial to meeting the military requirements of the 'hot' Cold War (and, in particular, the Korean (1950-1953) and Vietnam (1955-1975) Wars). This also led to US government stockpiling of the metal. Given aluminium's strategic

importance, and with decolonisation (and associated nationalisation of natural resources, including bauxite, in some newly emergent nations) between the 1950s and 1960s, this also proved an important point of negotiation between mature industrialised economies (largely in the northern hemisphere) and newly emergent mineral wealthy nations (predominantly in the global south).

As the next instalment (*The Age of Light Metal*) outlines, the principal driver of post-



Fig 4. Supermarine Spitfire Mk.I

1945 growth for the aluminium industry in the mature industrial economies was growing affluence and mass markets for consumer products, characterised by the

so-called 'Golden Years' of 1950-1973. However, the global conflicts of 1914-1918 and 1939-1945 were watersheds for the global aluminium industry in terms of its uses, organisation, and relationship with the state. ■

Supplementary reading:

Marco Bertilorenzi, *The International Aluminium Cartel: The Business and Politics of a Cooperative Industrial Institution (1886-1978)* (Routledge: London, 2015).

Hans Otto Frøland, Mats Ingulstad, and Jonas Scherner (eds.), *Industrial Collaboration in Nazi-Occupied Europe: Norway in Context* (Palgrave: London, 2016).

Robin Gendron, Mats Ingulstad, and Espen Storli (eds.), *Aluminum Ore: The Political Economy of the Global Bauxite Industry* (Vancouver: University of British Columbia Press, 2011).

Andrew Perchard, *Aluminiumville: Government, Global Business and the Scottish Highlands* (Carnegie: Lancaster, 2012).