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TUNGSTEN IN THE SECOND WORLD WAR: CHINA, JAPAN, GERMANY, THE ALLIES AND IBERIA

El tungsteno en la Segunda Guerra Mundial: China, Japón, Alemania, los aliados y la península ibérica

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This article studies the production, legal and illegal trade, and provisioning of strategic mineral wolfram/tungsten both by the Allies and the Axis during World War II. It analyzes the case the world's largest producer of this mineral, China, the trade agreements signed by Chiang Kai-shek before the war with Nazi Germany, the USSR and Britain and their evolution during the global conflict. It also analyzes Japan, its difficulties in obtaining Chinese wolfram and its dependence on Korea. As for Nazi Germany, it studies its supply of Chinese ore until 1941 and later in the Iberian Peninsula, a trade made difficult by the Allied preventive purchases in Spain and Portugal. The article also studies the case of the US, its progressive auto provisioning in the Western Hemisphere, the airlift established between China and India to extract tungsten and distribution of amounts of it in Britain and the USSR. Finally, the article includes an assessment of the importance of tungsten within the set of strategic materials used by the contenders in the war and concludes that the Allied strategy hinder or prevent the provision of the enemy helped to reduce use and negatively affected the effectiveness of its machinery of war.

Abstract

Wolfram; tungsten; Second World War; Second Sino-Japanese War; Nazi Germany; Japan; the United States; Soviet Union; Japan; Britain; Franco Spain; Portugal; smuggling; runners blockade.

Wolframio; tungsteno; Segunda Guerra Mundial; Segunda Guerra Chino-Japonesa; Alemania nazi; Japón; Estados Unidos; Unión Soviética; Japón; Gran Bretaña; España franquista; Portugal; contrabando; blockade-runners.

Key words

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Fechas

El artículo estudia la producción, comercio –legal e ilegal– y aprovisionamiento del mineral estratégico wolframio/tungsteno tanto por parte de los de los Aliados como del Eje durante la Segunda Guerra Mundial. Analiza al mayor productor mundial de este mineral, China, los acuerdos comerciales firmados por Chiang Kai-shek en la preguerra con la Alemania nazi, la URSS y Gran Bretaña y la evolución de los mismos durante el conflicto mundial. Analiza igualmente a Japón, sus dificultades para hacerse con el wolframio chino y su dependencia de Corea. En cuanto a la Alemania nazi estudia su aprovisionamiento de mineral chino hasta 1941 y posteriormente en la península ibérica, dificultado por las compras preventivas aliadas en España y Portugal. Estudia el caso de EE. UU., su progresivo autoaprovisionamiento en el hemisferio occidental, el puente aéreo establecido entre China e India para extraer el wolframio y la distribución de cantidades del mismo en Gran Bretaña y la URSS. El artículo incluye una evaluación de la importancia del wolframio dentro del conjunto de materiales estratégicos utilizados por los contendientes en la guerra y concluye que la estrategia aliada de dificultar o impedir el aprovisionamiento del enemigo contribuyó a disminuir su uso y lesionar la efectividad de su maquinaria de guerra.

Resumen

This paper examines the procurement and sale of tungsten (also known as wolfram[1]) during the Second World War[2]. Tungsten was one of the most sought-after strategic minerals during this period, one badly needed by the most important belligerent countries –Germany, the United States, the Soviet Union, the United Kingdom and Japan–[3] who obtained it at different times from China[4], the United States, Japanese-occupied Korea, British Burma, Bolivia, Portugal, Spain, the Union of South Africa, India and other countries or colonies. This strategic material was used as a component of special-purpose steels, essential in the production of armour-piercing shells and in reinforcing tank armour, gun barrels and warship decks, as well as in the manufacture of light bulb filaments. Furthermore, and most importantly, it was used in machine tools that employed cemented tungsten carbide in cutting tools, with properties equivalent to those of diamond, for cutting steel and other materials[5].

Tungsten was one of the most sought-after strategic minerals during Second World War

This paper has its origins in historical research into the relationship between the United States and Francoist Spain during the Second World War, in which I addressed the implications of the *Battle for Wolfram,* the political and economic conflict that set the Allies (USA & UK) aga-

1 Both names will be used indistinctively throughout the text.

2 The author wishes to thank the help provided in different instances of the research by professors Xiao Zili (South China Normal University at Guangzhou), Yang Hongyun (Tianjin University), Nobuo Tajima (Seijo University), Haruo Tohmatsu (National Defense Academy of Japan), Kenichi Arakawa (Shiseikan University), Kazuhiro Nogami (Tokyo Metropolitan University), Naoya Izuoka (Keio University), Ken Ishida (Chiba University), Haruko Hosoda (Nihon University), Chad Denton (Yonsei University, Seoul), Joao Paulo Avelas Nunes (Universidade de Coimbra), Rafael García Pérez, Xoám Carmona Badía and Emilio Grandío Seoane (Universidade de Santiago de Compostela), Macià Riutort (Universidad Rovira i Virgili), David S. Painter and Aviel Roshwald (Georgetown University), and Mats Ingulstad (Norwegian University of Science and Technology); as well as the documentary director Paula Cons; and mining engineers Joaquín Eulalio Ruiz Mora and Diego Casal.

3 In the case of Japan it is understood not strictly as Japan proper but also as including the annexed territories of Korea and Taiwan and the so-called Greater East Asia Co-prosperity Sphere (the annexed territories of Manchuria / Manchukuo, the Japanese occupied territories in China –that is to say, Nanging's China–, Burma, Philippines, and others) and the Japanese occupied Dutch and British colonies.

4 When talking about China, this refers to what is known as Free China –the territory not occupied by the Japanese–.

5 The adding of tungsten gives alloy-steels particular qualities, as toughness and resistance to heat and corrosion.

inst Franco from January to May of 1944[6]. It was the most serious conflict between Allied and Neutral states during the war. It involved, on the Allied side, an embargo on the sales of US oil and petroleum products to Franco's Spain, as a means of exerting pressure on the country to cease all exports of tungsten (both to the Allies and to Germany). In this way, the Allies hoped to leave the Nazis in short supply during the six months leading up to the Normandy landings and thereafter. During the embargo tensions were high between the US, which was opposed to yielding to Spanish counterproposals, and the UK, which favoured a less rigid embargo, permitting limited exports to the enemy according to its own need for other imports from Spain, including pyrite, oranges and other products. While the embargo had a significant impact on the Spanish economy, it did not prevent Germany from continuing to import Spanish tungsten: although in theory Spain did not authorize shipments to either side whilst these negotiations were in process, in fact, secretly and via smuggling, quantities of the mineral continued to reach Germany. In any case, the Spanish *Battle for Wolfram* had further consequences, because after it came to an end, the USA made radical changes in its policies towards Neutral nations, demanding (and achieving) an end their sales of raw materials and other products to the enemy.

My research into Spanish wolfram sales to both sides led me to ask where Nazi Germany had obtained it before it did so in Spain and Portugal, and to pose questions about the global importance of tungsten during the Second World War. This resulted, firstly, in an investigation into Chinese wolfram, the most important in the world in terms of production and exports since 1913; secondly, research into Japan's procurement sources for tungsten, including the role of Korean deposits, and the constant smuggling of minerals originating in China; and finally, a study of the evolution of the totality of Nazi Germany's wolfram supplies, first in China and India and then in the two Iberian countries.

Possessing enough wolfram, or even a surplus, during the Second World War, contributed, insofar as strategic materials did so within the general war effort, to the Allied victory

The case of Chinese wolfram exemplifies one of the two shifts in worldwide production of the mineral during the Second World War: for reasons we will explain, production in Asia, where there were rich deposits in China, Korea, Burma and Indochina, was eclipsed by the Americas, with deposits in the US, Bolivia and Argentina[7]. The second such shift involved Iberian wolfram (in the first instance Portuguese and then Spanish) when it became essential to a Nazi Germany that was unable to procure it in China, while at the same time, the Allies competed to obtain it, not so much because they needed it as in order to prevent the enemy from acquiring it in larger quantities.

Possessing enough wolfram, or even a surplus, during the Second World War, contributed, insofar as strategic materials did so within the general war effort, to the Allied victory. For its part, the Axis, while never exhausting its supplies of tungsten, was forced to use it less, especially in the manufacture of armour-piercing anti-tank missiles, but also in other war industries, which contributed to its defeat.

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6 Thomàs, J. M. (2011). *Roosevelt, Franco, and the End of the Second World War.* New York: Palgrave-Macmillan. Spanish version: (2010). *La Batalla del Wolframio: Estados Unidos y España de Pearl Harbor a la Guerra Fría (1941-1947).* Madrid: Cátedra.

7 This is derived from tables regarding the production of wolfram concentrates in the world by continent included in the book by Li, K.C., & Wang, Ch. Y. (1955). *Tungsten. Its Geology, Ore-Dressing, Metallurgy, Chemistry, Analysis, Applications, and Economics*. New York and London: Reinhold Publishing Corporation-Chapman & Hall, pp. 419-424.

1. Chinese tungsten and Nazi Germany, Japan, the Soviet Union, the United Kingdom and the United States

Since the beginning of the 20th century, China has been the world's largest producer of tungsten. Between 1913 and 1937 it accounted for 37 % of the world's total output of wolfram concentrates[8], producing 134,141 tonnes, followed by the British colony of Burma, with 17.4 % (63,067 tonnes) and the USA with 10.8 per cent (30,067 tonnes). Other producers included Bolivia (7 % - 25,605 tonnes), British Malaya (5.7 % - 20,590 tonnes), Portugal (4.7 % - 16,991 tonnes)[9], Japan (3.5 % - 12,600 tonnes), Australia (3.3 % - 11,932 tonnes), Argentina (2 % - 7,218 tonnes), Indochina (1.9 % - 6,922 tonnes), Spain (0.9 % - 3,900 tonnes) and the UK (0.9 % - 3,395 tonnes). Within China, 95 % of the tungsten was extracted in the Nanling region, a mountainous area that includes part of the southern provinces of Kiangsi, Kwantung, Kwangsi, Yunnan and Hunan, the first having the largest wolfram deposits and supplying 70 % of the total output of wolframite, the mineral form in which tungsten is most commonly found in the region[10]. During the inter-war period Chinese wolfram had already become an object of desire for countries including Germany, the Soviet Union, the United Kingdom, the United States, France, Italy, the Netherlands and Belgium. At the same time, fluctuations in its price were a barometer of expectations of peace or further wars, as occurred before and after the World Disarmament Conference in Geneva in 1932, when the prospects of an agreement first made the price fall and then –after talks failed– rise[11]. However, in China, wolfram production was not affected by the sudden slump in external demand that occurred in the rest of the producer countries at the end of the First World War, a slump that had been accompanied by a fall in prices, and by the closure of mines. Both the high quality of the mineral and low extraction costs, basically due to the low cost of Chinese labour, contributed to this effect[12]. On the other hand, production was temporarily affected by internal events, such as the civil war between the Communist Party of China and the government of the Republic of China that broke out in 1927, specifically between 1930 and 1934, when the main productive area, in the south of Kiangsi province, was occupied by the Red Army, which established a Soviet there. The encirclement of the area by Republican troops and the battles that took place there meant that many mines ceased production. Furthermore, the traditional (and less expensive) exit route for the mineral destined for export, transportation via river to reach Shanghai, was cut off, leaving only the alternative route, which led to Guangzhou by land. In fact tungsten production fell from 10,000 tonnes (1929) to 4,700 (1934). However, when the Communists withdrew in October 1934 to begin the Long March, production gradually recovered[13].

Fluctuations in the price of wolfram were a barometer of expectations of peace or further wars

8 Wolfram is used in the form of concentrates, which are produced by treating the mineral after it has been separated from the impurities or other minerals it is associated with. The most common level of concentration is 60 % WO_3.

9 Li-Wang, *op. cit.*, p. 413

10 Another one, very common in other places of the world, is scheelite.

11 First, up to 70 yuans per dan (Dan: One Chinese mass unit. There were 2 kinds of dan in tungsten business. One is Kupingdan, another is Dan. 1 ton= 16.8 Kupingdan=10 dan), and afterwards, up to 130: Zili, X. (2008). *The Head of Special Mineral: An Analysis on Development of Tungsten Industry in 1914-1919*. (PhD Dissertation) Sun Yat-Sen University, p. 60.

12 Zili, X. (2005). Development of Tungsten Industry in South Jiangxi Province in 1914-1949. *The Journal of Chinese Social and Economic History*, 3, 85-87.

13 *Ibidem*, p. 62.

Despite this temporary disruption, the importance of tungsten to the Chinese government as a commodity exclusively for export and as a significant source of income meant that during the remainder of the 1930s, efforts were made to establish a centralised system to control production. It was not a simple process, given the patchy and often weak influence that Chiang Kai-shek, the "Generalissimo" and supreme leader of the Republic, was able to bring to bear on certain areas of the country, which included the provinces where tungsten was produced. In fact, the provinces of Kiangsi and Kwantung had had their own controls from the late 1920s onwards, which had provoked complaints from business owners to the government of the Republic and, above all, a decline in production of the mineral. Centralised control –always limited– would not arrive until February 1936, in the shape of an Agreement on Control over the Tungsten Industry formulated by the Ministry of Economic Affairs, and passed by Executive Yuan's fourteenth meeting, which would establish central control over tungsten and construct a legal system for the tungsten industry[14].

However, the government's interest in the production and sale of wolfram went beyond its strictly commercial and fiscal aspects and was directly related both to the civil war affecting the country and to the complete occupation of Manchuria by Japan since 1931, with the threat that Japan posed to the stability and integrity of China. This threat took on a new and critical dimension with the outbreak, in July 1937, of the Second Sino-Japanese War (a war never formally declared by Japan) whereby the Japanese intended to seize the richest regions of the country. For this reason Chiang Kai-shek had sought ways of reorganising, training and equipping his armed forces with modern material and professional advice from overseas, to which end he had approached Germany, contracting military leaders and officers of the German armed forces. The most prominent among them was General Hans von Seeckt, the head of the mission sent by the German army, whom the *Generalissimo* named Adviser-general of the National Government between 1934 and his death in December 1936.

The Japanese invasion of 1937 and the subsequent war did not affect Chinese tungsten production until seven years later, during the final years of the Second World War

Fortunately for Chinese interests, the Japanese invasion of 1937 and the subsequent war did not affect Chinese tungsten production until seven years later, during the final years of the Second World War, in 1944. Until that time, Japanese forces were unable to seize control of producer areas. During the previous seven years, tungsten in areas controlled by Japan only accounted for 0.1 % of the total reserves. It was in 1944, in the course of the Japanese army offensive known as Ichi-Go, when the richest reserves were affected. However, the conquests of 1937-1938 had indeed –once again– disrupted transport routes along which the mineral arrived at export centres. When Shanghai was occupied by the Japanese at the end of October 1937, wolfram had to be redirected to Guangzhou; and when this city fell in October 1938, the tungsten route turned towards the British colonies of Hong Kong and Burma (specifically Rangoon), and French Indochina. For its part, the Chinese government, through the National Resources Corporation (NRC), sought –successfully– to guarantee and increase production of the mineral, granting incentives both to the miners and the mine owners, which took the shape of postponements of the call to military service, extra rice rations, and loans[15].

All of this, however, was not enough to forestall or halt the existence of a flourishing contraband market that derived from the pilfering of approximately 30 % of the output of Chinese tungsten

14 *Ibid.*, p. 189.

15 *Ibid.*, p. 87.

–according to figures from 1938– which originated in producer areas and was stimulated by the higher prices it was possible to obtain on the black market in Hong Kong, run in parallel to the colony's official market. The mineral arrived after circumventing the NRC's checks and being shipped in junks. Unsurprisingly, the country that took greatest advantage of the black market, in Hong Kong and later in the Portuguese colony of Macao or in British Rangoon, was Japan. In fact Japan's contraband purchases continued throughout the world war, because after Japan occupied Hong Kong and Rangoon, wolfram continued to be smuggled there. As for legal purchases in the two British colonies, these continued until March 1941, at which time the United Kingdom banned them.

The history of exports of Chinese tungsten to the Great Powers during the 1930s tracked developments in international politics during this tumultuous period; and of course, to an even greater extent, the not always stable alignments of the powers during the Second World War.

Hitler's coming to power brought a renewed German interest in obtaining Chinese wolfram as part of the policy of rearmament and preparation for war

As regards Nazi Germany, Hitler's coming to power brought a renewed German interest in obtaining Chinese wolfram as part of the policy of rearmament and preparation for war. Germany had already used the mineral during the First World War, obtaining it during the pre-war period in the tungsten mines of Wales[16] and purchasing it during the conflict –as did Austria-Hungary and the countries of the Entente– from Portugal and Spain[17]. But from 1933 onwards, it worked with renewed interest to sign trade agreements with China that would allow for wolfram and other strategic materials to be exchanged for arms and industrial products on a massive scale. At the same time, this new interest entailed a radical break from previous policies –those of the Weimar Republic and its army– that favoured the military relationship with the Soviet Union.

These conversations with China took place with the central government and some provincial governments, especially with that of the principal wolfram-producing province, Kiangsi[18]. As a result, on 23 August 1934, the first agreement was signed –the Treaty for the Exchange of Chinese Raw Materials and Agricultural Products for German Industrial and other Products– on the exchange of tungsten for arms and industrial products[19]. On the Chinese side, it was signed by a representative of the central government, and on the German side by the head of the Handelsgesellschaft für Industrielle Produkte (HAPRO), a consortium created by the army and the German economic ministries in order to group together all the official and private companies that were operating in China. Two years later, on 8 April 1936, the agreement was replaced by another, which was also based on barter, and would thus allow China to receive new weaponry and various kinds of industrial equipment without going into debt. However, on 25 November of the same year, Germany signed the Anti-Comintern pact with Japan, making it clear which strategic options took priority for Hitler in the Far East. This was a hard blow for the Chinese, who had not expected it. The fact was that the Fuhrer regarded Japan as a more important ally than China in a future war against the USSR. He had in mind Russia's defeat by Japan in the 1904-1905 war, and also regarded China as incapable of resisting Soviet attacks. Furthermore,

16 Li-Wang, *op. cit.*, xi;

17 Caruana de las Cagigas, L., & González Calleja, E. (2014). La producción y contrabando de wolframio en España durante la Primera Guerra Mundial. *Ayer*, (95).

18 Zili, X. (2008). Nationalist government's attempt on tungsten control and the establishment of tungsten control. *Historical Research*, 1, 116-117. In order to gain a complete insight of the negotiations, see Kirby, W. C. (1984). *Germany and Republican China*. Stanford: Stanford University Press, pp. 102-144.

19 Strauss, H. (2001). *Deutschland und der Japanisch-chinesische Krieg.* Seminararbeit, pp. 86-88.

from a racial point of view, he considered the Japanese superior to the Chinese, whom he had compared to African Americans in his book *Mein Kampf*[20].

However, despite this clear inclination towards one of the two opposing sides then engaged in a war on Chinese territory, Germany did not break off commercial relations with China, and over the next two years would continue to obtain tungsten in exchange for supplying arms and industrial products. But these exchanges took place against a background of significant disagreements within the upper echelons of Nazi leadership. So while in 1938 the new Foreign Minister, Von Ribbentrop –who replaced Von Neurath– had granted diplomatic recognition to Manchukuo (the Japanese puppet state established in 1932 in Manchuria, another Chinese region occupied by the Japanese), and Goering –in charge of the Four Year Plan– had ordered that the deliveries of German war materials contracted under existing agreements should stop, and the military mission that worked closely with Chiang Kai-shek had been withdrawn during the following months of May and June…[21] the need for wolfram as a key element for German industry and rearmament led the Wehrmacht and Finance Minister Funk to advocate the continuation of these agreements to Hitler, and had been successful. In fact, in October 1938 HAPRO, with the approval of Funk and the opposition of Ribbentrop, had signed a new barter agreement to the value of 7.5 M Reichmarks a month[22].

The Germans' first attempt to maintain imports of Chinese wolfram during the war was to transport it through Soviet territory

Despite this, the cooling of relations was a fact, and brought about a decrease in the amount of Chinese wolfram arriving in Germany, which fell first from 8,962 tonnes in 1938 to 4,142 tonnes in 1939 and later, dramatically, after the outbreak of war in September 1939, to 420 tonnes in 1940[23]. A key part in this decline was played by gradual establishment of a naval blockade by the United Kingdom, even though Germany struggled to circumvent it with blockade-running surface vessels and, later, with submarines. The Germans' first attempt to maintain imports of Chinese wolfram during the war was to transport it through Soviet territory. This was possible thanks, on the one hand, to the economic agreement that complemented the Ribbentrop-Molotov on 23 August 1939 as well as other pacts concluded in early 1940[24]; but also and in particular, because of other agreements that were in effect, this time between China and the Soviet Union, dating from 1938 and 1939. Japan was also a factor.

The routes used to transport the mineral were a maritime one from Hong Kong to Vladivostok (with cargos disguised as Soviet consignments to get around the British ban on supplying the enemy, in force since 1939), which connected to the trans-Siberian railway and then Germany; but also a land-only route that passed through the territory of Manchukuo to reach the USSR and, from there, Germany. On this latter route, the mineral was collected in Guiyang and transported to Xingxingxia, or originally to Hami, even further away. However, it seems that Japanese

20 Kirby, *op. cit.,* p. 140.

21 *Ibidem*, p. 235.

22 *Ibid*., p. 246

23 *Id*., p. 248.

24 On February 11th 1940 both countries signed a new economic agreement by virtue of which the USSR would deliver "larger quantities of oil, grain, timber, iron and various non-ferrous ores. Also, it would offer transit facilities for certain raw materials from the Middle East and the Far East –notably rubber and a million tons of soybeans from Manchuria–" Wright, G. (1968). *The Ordeal of Total War 1939-1945.* New York: Harper & Row, p. 57.

cooperation was not especially active[25], probably due to its own need for Chinese tungsten[26]. In any case, the end of the trade between China and Germany would not come until shortly after the Nazis attacked the USSR, when China declared war on Germany.

In parallel to the efforts it made to maintain its agreement with Nazi Germany, but also in light of the uncertainty into which the relationship had been plunged since 1936-1938, Chiang Kai-shek's government reacted by signing new trade agreements for the sale of tungsten and other strategic materials to other countries. Between 1938 and the outbreak of the Pacific War –after the Japanese attack on Pearl Harbor on 7 December 1941– it signed economic treaties with the Soviet Union, the United Kingdom and the United States. The first two were, similarly to those signed with Germany, barter agreements, exchanging military and industrial equipment for tungsten and agricultural and mineral products. By contrast, those signed with the United States were different: China would sell wolfram (as well as tung oil and tin) and with the profits they obtained pay off the loans granted by the US for the purchase of arms[27].

With the Soviet Union –which had no tungsten deposits within its own territory and needed the mineral urgently– and within the framework of the Sino-Soviet Non-Aggression Pact of August 1937, China signed three agreements, two in 1938 (1 March and 1 July) and a third in 1939 (13 June), to a value of 250 million dollars, which would be paid off by the Chinese with wolfram, antimony and tin[28]. In exchange, China received 600 aircraft, 1,000 guns and howitzers and 8,000 machine guns, as well as Soviet military attachés and air crews[29]. However, when Germany attacked the Soviet Union in June 1941, it cut off Soviet military assistance to China, as well as the trans-Siberian railway[30] and thereafter Chinese wolfram would arrive in the USSR by slower routes and, in particular, as we will see, by a new route, involving nothing less than an airlift, conducted by the US.

The end of the trade between China and Germany would not come until shortly after the Nazis attacked the USSR

The Chinese government signed two agreements on tungsten with the United Kingdom –in August 1939 and in June 1941– to a value of 6 million pounds. Rather than procuring the mineral for themselves –they obtained 77 % of their supplies[31] from the colonies in Burma, the Malay States and Straits Settlement, and a smaller proportion from Welsh mines– Britain's greatest concern after the outbreak of war in 1939 was firstly, to prevent Nazi Germany and (after spring 1941) Japan from obtaining the tungsten that was leaving by sea from Hong Kong, Rangoon or any other British or Allied colonial port. For this reason, from the beginning of the war onwards

25 Akira, K. (2009). The Reality of Wartime Economic Cooperation: From Germany's Blitzkrieg Victory to its War with the Soviet Union. In Kudo Akira, Tajima Nobuo, Erich Pauer (Eds.). *Japan and Germany. Two Latecomers to the World Stage, 1890-1945* (Volume I: 'A Chance Encounter in East Asia') (p. 344). Folkestone: Global Oriental.

26 The Japanese provided only few ships monthly for the transport of goods to Vladivostok, language difficulties, lack of trained personnel, delay in transit permits, and considerable mistrust among German, Russian, and Japanese officials: Kirby, op. cit., p. 244.

27 Xiao Zili, "The head…" Cit., p. 203.

28 *Ibidem*.

29 Fallin, Soviet Peace Efforts on the eve of World War II (September 1938-August 1939), Documents and Records, Novosti Press Agency Publishing House (19739: 45) cit. Bingyan Cai, The Search for Allies: Chinese Alliance Behavior from 1930 to the End of WWII. A Professional Paper Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Arts In Diplomacy and military Studies (Hawai'I Pacific University, 2009), p. 45-46.

30 Chou Whei-Ming, Ch. (2009). The Wang Jing-wei regime and the German Japanese Alliance. In Kudo Akira, Tajima Nobuo, Erich Pauer (Ed.). *Japan and Germany. Two Latecomers to the World Stage, 1890-1945* (p. 373). Folkestone: Global Oriental.

31 Hurstfield, J. (1953). *The Control of Raw Materials*. London: Her Majesty Stationery Office and Longmans, Green and Co., p. 167.

they established a system of export licences, a system that would not, however, succeed in preventing ongoing tungsten smuggling, which placed a not inconsiderable percentage of Chinese output on the international market, at prices that were between 10 and 20% lower than the official ones –a circumstance that furthermore placed downward pressure on the prices set by the Chinese NRC–. Throughout 1940, the British government had been unsure how to prevent this illegal trade out of Hong Kong, and contemplated the creation of a body that would purchase all the wolfram that arrived there, but feared that this would displace the black market to Macao. Meanwhile, it demanded that Japan agree to use the tungsten purchased legally in the colony solely for domestic consumption, and prohibited it from ceding the mineral to third countries (in other words, Nazi Germany). Japan formally accepted these demands… while continuing its purchases on the black market, and continuing to send mineral to Germany via the USSR, or via blockade-runners. The situation was to change, however, in March 1941 when the British ceased to grant wolfram export licences to Japan and decided to create the Metals Purchasing Board in Hong Kong, the body through which they intended the NRC to control all tungsten purchases in the colony, to sell it to the United States afterwards. This did not prevent the Japanese from continuing to get hold of varying amounts of smuggled mineral either. But after Pearl Harbor, Japanese prospects would improve once again, after the occupation of Hong Kong (25 December, 1941), Rangoon (7 March, 1942) and the whole of Lower Burma. Furthermore, the following April, the Japanese advanced north and cut off the Burma Road, the land route that connected Burma and China, a route whose construction had begun following the outbreak of war between China and Japan, it objective being for Chinese products to be able to get around the Japanese naval blockade. The route had been operational since 1939. With the road cut off, and the Japanese occupation of most of British Burma, the arrival of Chinese wolfram in the United Kingdom came to depend entirely on the United States.

In this first deal, the United States granted China a 25 million dollar loan in exchange for 30 million dollars' worth of tungsten

The United States –the world's third-largest producer of wolfram in the pre-war period, whose output would almost equal that of China during the Second World War– signed three commercial agreements with Chiang Kai-shek's government after 1939, relating mainly to tungsten, as well as a further two on products such as tung oil (the agreement of 25 February 1939 to the value of 25 million dollars in exchange for 220,000 tonnes) and tin (that of 20 April 1940 to the value of 20 million dollars[32] in exchange for 40,000 tonnes). The first of those relating to wolfram –that of 22 October 1940– followed a request from Chiang Kai-shek made immediately after Japan's signing of the Tripartite Pact on 27 September 1940 and the occupation of the northern part of French Indochina –held by the Vichy government– at the end of the same month; an occupation that cut railway links to China[33]. In this first deal, the United States granted China a 25 million dollar loan in exchange for 30 million dollars' worth of tungsten.

The second agreement, of 30 November 1940, consisted of a 100 million dollar loan, again in exchange for tungsten as well as antimony and tin[34]. But the most important agreement came shortly after Pearl Harbor, in early 1942, when the United States granted a third loan, extre-

32 Marshall, J. (1995). *To have and have not. Southeast Asian Raw Materials and the Origins of the Pacific War*. Berkeley and London: University of California Press, pp. 39-40.

33 In June 1940 the US had carried off a large consignment of Chinese wolfram stockpiled in French Indochina, taking it before the Germans and Japanese could do so. This audacious operation led to the Vichy regime's removal –at German insistence– of the governor, General Georges Catroux, and his replacement by Admiral Jean Decoux. The four merchant vessels sent by the US to transport the wolfram were pursued by the Imperial Navy, without success: Li-Wang, op. cit., p. xiv-xv.

34 Marshall, *op. cit*., p. 40.

mely generous and of the utmost strategic value, to the value of 500 million dollars, without specifying its purpose except in the most general terms: "to assist in the war against Japan and to contribute to the stabilization of China's wartime economy"[35]. Of this sum, a considerable proportion was dedicated to the purchase of tungsten and other Chinese mineral and agricultural products.

In total, between 1938 and 1945, the United States granted China 1,500 million dollars in loans, not counting the 846 million in *materials and services* supplied under the Lend-Lease law, beginning a month after the law was passed in March 1941[36]. After the United States entered the war, there were two exit routes for Chinese goods: the air route to which I have referred above, which was the principal one, and a land route. On the former, aircraft carried wolfram concentrate from China to eastern India and from there to the north by railway, to the west coast of the subcontinent, from where it was shipped to the United States, Great Britain and the USSR. On the latter, the mineral was sent north to the Soviet Union. The air route soon became known as "The Hump" because the aircraft flew over the Himalayas

In short, most of the Chinese tungsten –with the exception of that smuggled by the Japanese– ended up in the hands of United States

In short, most of the Chinese tungsten –with the exception of that smuggled by the Japanese– ended up in the hands of United States, which used it in industry but also distributed some to the Soviet Union and the United Kingdom during 1942, 1943 and the first months of 1944. Thereafter, from mid-1944 onwards, the USSR would be the main beneficiary, receiving all the wolfram extracted from China, as result of the oversupply of the mineral in the United States.

The United States' interest in Chinese wolfram, and the organisation of the airlift to export it, should be placed in the context of the general mobilisation into which the country flung itself immediately after Pearl Harbor. At the end of 1941 Secretary of State Cordell Hull had approached Chiang Kai-shek, offering to purchase wolfram and other raw materials needed for the US war effort on a massive scale. He had two aims: procurement for his own industries, and the extraction of minerals from producer areas that were liable to fall into Japanese hands. Faced by the same threat, and in their own Asian colonies, both the British and the Dutch had reacted by applying a scorched earth policy when the Japanese began their advance towards Burma, Malaya and the Dutch East Indies. In fact, production of the first two would –for this very reason– be greatly reduced throughout the rest of the conflict[37]. But it was only after the fall of Rangoon[38] and the cutting off of the sea route to its port, as well as the Burma Road, that the United States had decided to activate the new air route between China and India[39]. On the 20-25 March 1942, meetings were held in Chungking –the seat of the government of Free

35 "Summary of United States Government and Military Aid Authorized for China since 1937" January 1950. State Department Memorandum quoted in Kirby, W.C. (2015). The Chinese War Economy. In James C. Hsiung & Steven I. Levine, *China's bitter victory. The war with Japan 1937-1945*. London: Routledge, p. 200 (reprint from Taylor & Francis, 1992); Schaller, M. (1979). *The United States and China in the Twentieth Century.* New York: Oxford University Press, p. 72.

36 "Second Report under the Act of March 11, 1941 (Lend-Lease Act)", *Academia Sinica,* Institute of Modern History, *Mei guo jun yuanhua (The American military and financial assistance to China),* Box 1, 23-4 quoted in Chen Hao (2015). *Negotiating for Alliance. Republican China's Relations with National Socialist Germany and the United States, 1937-1941.* Montreal: MA Th, McGill University, p. 80.

37 Li-Wang, *op. cit*., p. 422.

38 US Embassy Chungking to State Department, April 19, 1942. RG 234 Records of the Reconstruction Finance Corporation. Metals Reserve Company. National Archives and Records Administration (NARA-2).

39 Telegram State Department US Ambassador to Chungking December 27, 1941; telegram US Embassy Chungking to State Department, December 31, 1941. RG 234 Records of the Reconstruction Finance Corporation. Metals Reserve Company. National Archives and Records Administration (NARA-2).

China– between Lieutenant general Stilwell –head of the US Military Mission to China, Lend-Lease supervisor and Chiang Kai-shek's Allied chief of staff– Dr Wong Wen-hao –Minister of Economic Affairs and Chairman de la NRC– and Teichman, an adviser at the British Embassy, to organise the airlift, which would link the Chinese airport of Dinjan with aerodromes in the India state of Assam, and, from there, by train, to the ports of Bombay and Karachi. From there, the goods would be shipped to the United States, arriving two to three weeks later. A proportion would then be sent on to the United Kingdom and the Soviet Union.

At that time, in March 1942, there were 5,150 tonnes of wolfram in China awaiting transport, and to begin the process, 25 aircraft carrying US war supplies were to arrive in Kunming. They would then return to India carrying tungsten and other minerals. It was also in these meetings that the opening of land route to connect China and India, passing through Higher Burma, was first suggested[40]; a road that would be built and would be known as *Ledo* (the name of the Indian town and railway terminal where it was to end) *Road* or *Stilwell Road*. This route, however, would not be completed until 1945.

As a result, depending exclusively on the air route, the transport of Chinese wolfram was organised, between July 1942 and February 1943, under contract to the official China National Aviation Corporation (CNAC), by the US Company Pan American Airways. The transport was in fact paid for by the United States with funds from the Metals Reserve Company of the Board of Economic Warfare[41]. Later, from the second of the dates mentioned and until the end of the war, the CNAC used between 24 and 26 aircraft supplied through the Lend-Lease agreement for the Services of Supply, United States Army Forces in China, Burma and India. The trade-off was always the same: the aircraft carried military supplies from India and returned with consignments of wolfram, antimony and tin[42] via a 500 mile air bridge[43].

The United States went from urgently needing Chinese wolfram to a situation of oversupply

However, as we have mentioned, over this two-and-a-half-year period the United States went from urgently needing Chinese wolfram to a situation of oversupply. This accumulation of stocks was caused both by increased production in the country's own mines (which during 1942 and 1943 had been able to produce 8,467 and 10,836 tonnes of wolfram concentrates respectively) and by imports of wolfram from Bolivia (producing 5,606 and 6,902 tonnes in the same period) and Argentina (2,115 and 2,390 tonnes)[44]… and also, to a certain extent, by the Chinese taking advantage of the agreement to send wolfram in larger quantities than those agreed for each year[45]. In fact, by August 1943, US authorities estimated that total wolfram imports for the

40 Enclosure n. 1 to dispatch n. 330 March 24, 1942 US Embassy Chungking to State Department. RG 234 Records of the Reconstruction Finance Corporation. Metals Reserve Company. National Archives and Records Administration (NARA-2).

41 State Department and Board of Economic Warfare authorization July 8, 1942 included in Memorandum from Metals Reserve Corporation to Treasury Department April 4, 1943. RG 234 Records of the Reconstruction Finance Corporation. Metals Reserve Company. National Archives and Records Administration (NARA-2).

42 Memorandum by Second Secretary of Embassy in China, December 12th, 1944. *Foreign Relations of the United States (FRUS) 1944, vol. VI China*, p. 202-205.

43 Contract between China National Aviation Corporation and Service of Supply American Army Forces in China, Burma, and India. February 17, 1943. RG 234 Records of the Reconstruction Finance Corporation. Metals Reserve Company. National Archives and Records Administration (NARA-2).

44 Li-Wang, *op. cit.*, p. 419.

45 Telegram Foreign Economic Administration to US Embassy Chungking November 24, 1943. RG 234 Records of the Reconstruction Finance Corporation. Metals Reserve Company. National Archives and Records Administration (NARA-2).

whole year would reach 27,150,000 pounds, when projected consumption was 22,000,000[46]. By 1944 the situation was even worse, with projected imports at 47 million pounds, and consumption at 24 million… a figure soon lowered to 19, a level it was possible to cover from the country's own production and imports from Bolivia and Argentina[47]. But this did not alter the United States's commitment to extracting wolfram and other minerals from Chinese territory[48]. The solution to the oversupply problem was to send most of the tungsten extracted in 1944 to the Soviet Union and, in 1945, to send all of it. In fact, in 1944 the United States kept only 1,623,000 pounds of Chinese tungsten while the USSR received 11,550,000[49].

The solution to the oversupply problem was to send most of the tungsten extracted in 1944 to the Soviet Union

However, during the last year of the war, the production and transportation of wolfram in Free China was seriously compromised by Japanese military operations; specifically by the Ichi-Go campaign, the series of three separate battles in the Chinese provinces of Henan, Hunan and Guangxi intended to connect Japanese occupied areas in China with French Indochina, and capture air bases in southeast China from which American bombers were attacking the Japanese homeland and shipping. Fighting affected wolfram producer areas, and cities such as Dayu and Ganzhou in Jiangxi Province, Nanxiong and Lechang in Guangdong Province, fell in 1944 or 1945. China's tungsten industry was almost brought to a complete halt. According Xiao Zili, mines in Jiang Province ceased production in the summer of 1944:

On 3rd July, Tungsten Management Office's Eighth office in south Jiangxi Branch received an order, commanding it to stop purchasing tungsten, dismiss the miners and shut down the mines temporarily due to the transportation problem and difficulty of getting money. Yaogangxian Mine was forced to stop when Henyang in Hunan Province fell in August 1944. Zhengjiang Company and Minsheng Company were two tungsten companies that operated the longest in Guidong, Hunan Province. They never stopped producing tungsten since the First World War. These two companies stopped the business successively in 1944 when the battles became worse, the transportation became harder, and the market demand was small[50].

In fact, output in 1944 and 1945 would only be a third of 1943's, falling from 9,734 tonnes in 1943 to 3,502 and 2,929 respectively. Whether the Japanese were able to obtain this tungsten was another matter, and appears not to have been the case, as we shall explain below.

46 US Embassy Chungking to Foreign Economic Administration, August 7, 1943 RG 234 Records of the Reconstruction Finance Corporation. Metals Reserve Company. National Archives and Records Administration (NARA-2).

47 Memorandum to Major Gunderson quoting Combined Raw Materials Board-War Production Board-Tungsten Branch figures. December 4, 1943. RG 234 Records of the Reconstruction Finance Corporation. Metals Reserve Company. National Archives and Records Administration (NARA-2).

48 *Ibidem*.

49 Air Transportation of Strategic Materials from China to India. Reports. RG 234 Records of the Reconstruction Finance Corporation. Metals Reserve Company. National Archives and Records Administration (NARA-2).

50 Xiao, Zili. The Head of Special Mineral… cit., p. 63

Table 1. China's foreign loans involving tungsten ore before the pacific war

Country	Date	Loans	Duration (Years)	Deadline	Collateral
Germany	April 1936 Verbal agreement July 1938.	One hundred Reichmarks 7,5 M Reichm/month	Not limited	1939	50% agricultural products; 50% mineral products.
Soviet Union	March, 1 1938	U.S.$50 million	5	1943	50% agricultural products; 50% mineral products.
	July,1 1938	U.S.$50 million	7	1945	50% agricultural products; 50% mineral products.
	June, 13 1939	U.S.$150 million	13	1952	50% agricultural products; 50% mineral products.
Britain	August, 18 1939	£3 million	15	1954	50% agricultural products; 50% mineral products.
	June, 5 1941	£3 million	15	1956	50% agricultural products; 50% mineral products.
United States	February, 9 1939	U.S.$25 million	5	1944	220,000 tons of tung oil
	April, 20 1940	U.S.$20 million	7	1947	40,000 tons of Yunnan Tin
	September, 25-October, 22 1940	U.S.$25 million	5	1945	U.S.$30 million worth of tungsten ores
	November, 30 1940[51]	U.S.$100 million	7	1948	tungsten, tin and antimony.
	February 1941	U.S.$500 million			agricultural and mineral products, Tungsten

Sources: Zili, X. (2008). *The Head of Special Mineral: An Analysis on Development of Tungsten Industry in 1914-1919.* (Ph D Dissertation) Sun Yat-Sen University, p. 201; USSR 150 M credit in: Sun, Ke, *Zongsu Guanxi [Sino-Soviet Relations]* (Shanghai: Zhonghua Shuju, 1946), pp. 513-514; Marshall, J. (1995). *To have and have not. Southeast Asian Raw Materials and the Origins of the Pacific War.* Berkeley Los Angeles: University of California Press, pp. 39-40.

2. Japan, Korean tungsten and the continued smuggling of Chinese tungsten

Japan, unlike the United States (which had deposits in its own territory) and Nazi Germany and the Soviet Union (whose ability to produce their own was insignificant) but like the United Kingdom (which had wolfram in some of its colonies), had access to considerable amounts of tungsten in its foreign possessions. And in one in particular: Korea. At the same time, in contrast to Great Britain's situation with respect to its wolfram-producing colonies, the Korean peninsula was close to the Japanese mainland and, five years after occupation in 1905, Japan annexed Korea, so formally it was part of the country. Korea provided 60 per cent of the tungsten Japan required, with production continually rising after 1934, reaching maximum levels ten years later at 8,403 tonnes of wolfram concentrate[52]. Mainland Japan had small deposits of its

51 The signing dates of the contracts between China and the US do not match in all the sources. According to two letters from the Metals Reserve Corporation to the US Commercial Corporation dated April 14th 1944, when the transfer of the management of the programs of New Caledonia and China to the USCC, they were: 10/22/1940; 1/31/1941; and 6/4/1941: Metals Reserve Corporation to USCC April 19, 1944. RG 234 Records of the Reconstruction Finance Corporation. Metals Reserve Company. National Archives and Records Administration (NARA-2).

52 Li-Wang, *op. cit.*, p. 422.

own –which supplied another 10 %– while to meet the rest of its needs, before the outbreak of the Pacific war, it depended on imports from British colonies –including Burma, Malaya and Hong Kong– the United States, Bolivia, the Philippines[53] and China. At the same time, and as we have described, legal procurement from this last country was interrupted in 1937 after the invasion, as a result of which Japan had to purchase Chinese tungsten in Hong Kong and other colonies, both legally and through non-official channels.

In 1939, with the outbreak of the war in Europe, the transport of tungsten by sea to the West had become difficult and risky, and as a result the amount of the mineral available in Hong Kong, Macao and Rangoon increased. This allowed the Japanese to acquire larger quantities of wolfram, both legally and illegally. In Hong Kong in particular, Japan became the principal purchaser of wolfram: between January and April 1940 alone, it acquired 606 tonnes[54] [3998] and around 1,400 dans of tungsten were transported to Japan from Hong Kong each month, equivalent to 1,000 tonnes a year[55]. And when in March 1941, Britain banned Japanese purchases of the mineral in the colony, they used Macao and Kwangchowwan as supply lines, as well as organising extraction operations in Tamshui (Sancho Islands)[56], which was in their possession.

The smuggling of Chinese tungsten remained a constant throughout the war

As we know, a small proportion of the wolfram obtained by Japan was sent to Germany via the USSR or via blockade-runners[57]. Later, after the outbreak of the Pacific war and Japan's conquest of much of Burma, the Dutch Indies and other territories, as well as the Ichi-Go campaign in territories in south east China, the Japanese significantly increased their ability to obtain large quantities of wolfram, but the scorched earth policy practised by the British and the Dutch in Burma and Malaya and, later, the naval blockade and attacks on Japanese shipping, prevented the arrival of the mineral in large quantities to the Japanese mainland. Nevertheless, the smuggling of Chinese tungsten remained a constant throughout the war[58].

As a result of these difficulties and of the growing demands of its war industries, Japan's dependence on Korean wolfram increased. And while Korean production tripled within a few years –reaching 7,000 tonnes in 1943[59], whereas in 1937 it had stood at about 2,000–[60] and with an increase –within Korea itself– of production the special steel that contained wolfram (with a capacity of 20,000 tonnes in 1943) this could never make up for the deficit, which remained at

53 Montis Ruhl Kleeper (1947). Tungsten Resources of Japan. (Report no. 77. Tokyo, General Headquarters, Supreme Commander for the Allied Powers, Natural Resources Section, 1947), pp. 1, 6, 7.

54 Report "Hong Kong Wolfram May 31, 1941" from P. C. Sedwick Colonial Administrative Service to S. Strauss US Embassy Chungking. RG 234 Records of the Reconstruction Finance Corporation. Metals Reserve Company. National Archives and Records Administration (NARA-2).

55 Around 1,400 dans of tungsten were transported to Japan from Hong Kong each month, which means 1,000 tonnes in a year: Zili, X. (2007). Japan looted China's tungsten ores and how Nationalist government responded in wartime. *The Journal of Studies of China's Resistance War Against Japan*, 1, 140-143.

56 Report "Hong Kong…" cit.

57 The main raw material transported from the Far East was natural rubber, but also varying quantities of edible oils, wolfram, tin, opium and quinine arrived: Martin Brice, *Axis Blockade runners of World War II* (London: BT. Brantsford, 1981), p. 151; see also Kudo, *op. cit.*, p. 374; and Dietrich Eichholtz, *Geschichte Der Deutschen Kriegswirtschaft 1939-1945, Band III: 1939-1945, Tel* 2 (Saur, 1999).

58 Xiao, Zili. "Japan looted…" cit.

59 7,056 exactly, according to Chad Denton in his article (2013). More Valuable than Gold. Korean Tungsten and the Japanese War Economy, 1910 to 1945. *Seoul Journal of Korean Studies*, 2(26), 3.819; or 6,932 according to Li-Wang (*op. cit.*, p. 422).

60 2,058 according to Harold Glenn Moulton-Louis Marlio (1944). *The Control of Germany and Japan*. Washington DC: Brookings Institution, p. 68; or 1,590 according to Li-Wang (*op. cit.*, p. 422).

35 % for the duration of the war[61]. This forced Japan to reduce the amount used in alloys and to replace some elements with other combinations.

At the same time it is important to remember that, as in Germany and the other belligerent countries, in Japan, the procurement of tungsten or any other raw material was not the most fundamental limiting factor in the war economy. For Japan, this was its very low iron and steel production[62]. As a result, Japan had to make cuts in its programs of shipbuilding and ammunition, to reduce the number of warships, and to have more cargo ships because there was not enough steel for both; the country also had to make cuts in heavy artillery and armoured combat vehicles to boost aircraft production. A great deal of rivalry, administrative problems and bickering arose from the fact that Japan only produced 1/13 of what the US could[63]. Furthermore, in respect of raw materials, as B. Cohen states:

[…] shortages of other strategic minerals like chromium, nickel, vanadium, titanium and molybdenum led to a decline in the quality of the alloy steels used in engine production, landing gears, motors mounts and terminal fittings. It was a combination of bad foresight and poor planning: 2 or 3 shiploads a year of tungsten concentrates would have provided a large stockpile. In fact, the blockade together with the mining of ports, attacks on shipping, and to a lesser extent, aerial bombardment of arms factories, would led to the gradual collapse of the Japanese war economy, but only during the last year of the conflict[64].

Table 2. Tungsten ores transported to japan from Hong Kong from 1938 to 1940

Time	Quantity (Dan)	Value (Yuan)	Data Sources
1938 September-December	725	\	(Hong Kong) "Sing Tao Daily" 17th July, 1939, page 12
1939 January-June	513	75,337	(Hong Kong) "Sing Tao Daily" 17th July, 1939, page 12
1939 September-December	7,893	1,845,868	(Hong Kong) "Sing Tao Daily" 17th July, 1939, page 3
1940 January-February	8,073	Around 1,880,000	Xu Xiuling's, How to stop smuggling in South China quoted from Qi Chunfeng's Smuggling in Sino-Japanese Economic War (1937-1945), p. 244-P247
1940 March-April	8,073	1,882,157	(Hong Kong) "Sing Tao Daily" 23rd August, 1940, page 2
Total	25,285		

Source: Zili, X. (2007). Japan looted China's tungsten ores and how Nationalist government responded in wartime. *The Journal of Studies of China's Resistance War Against Japan*, 1, 140-143.

61 US Stategic Bombing Survey, *Coals and Metals in Japan's War Economy*, p. 2.

62 Cohen, B. (1949). *Japan's economy in war and reconstruction*. Minneapolis: Jerome University of Minnesota, p. 114.

63 *Ibidem*, p. 124.

64 *Ibid*.

3. Germany after the end of large-scale tungsten procurement in Chinese: Iberia

Unlike the United States, Germany had only tiny deposits of tungsten in its own territory. However, it was able to take over some small deposits in countries it occupied in 1940, as was the case in France. While for Germany the most important strategic mineral for arms production was not tungsten but chrome[65], tungsten was indispensable in the manufacture of high-speed machine tools[66], and as a component of some types of ammunition (the tips of anti-tank projectiles) and armour. We still do not know how much tungsten German industry needed before the Second World War; on the other hand, we do know, as we have already seen, that from 1936 onwards it procured supplies principally in China, but also in other countries, including, on a small scale, the Iberian Peninsula. Specifically, in 1937 it imported 8,037 tonnes from China, 1,229 from India, 304 from Portugal and, lastly, 141 from Spain[67], where Hitler had been supplying military aid to General Franco during the Civil War in exchange for a range of mineral and agricultural products[68], which included wolfram. With China, Germany formalised the barter agreements described above, with which it was able to guarantee its supplies for three years. Thereafter, as we have seen, it would receive small quantities of the mineral via the USSR and Japan, because the outbreak of the World War had blocked direct access to the Chinese market and the remaining Asian and South American markets.

For Germany, tungsten was indispensable in the manufacture of high-speed machine tools, as a component of some types of ammunition and armour

We can appreciate the impact that the loss of the Chinese market had for Germany in the following table:

Table 3. German wolfram imports. Total and from china 1933-1939 (1,000 tons)

	1933	1934	1935	1936	1937	1938	1938 (Jan-August)	1939 (Jan-August)
China	1,9	2,5	4,8	5,1	8	9	6,3	7,3
Total	3,8	4,4	7,9	8,7	11,4	14,2	8,9	7,3

Source: Re-done from Jäger, J. (1969). *Die wirtschaftliche Abhängigkeit des Dritten Reiches von Ausland. Dargestellt am Beispiel der Stahlindustrie*. Berlin: Berlin Verlag, p. 157.

65 Chrome (…) is the very base of all alloy-steels. Without chrome a highly developed armament industry cannot be kept functioning (…) The loss of the Balkans –and consequently the loss of Turkish deliveries- would mean that (…) after having used the raw-blocks in store (…) the various most important armament industry branches; aircraft, panzers, motor-vehicles, anti-tank shells, U-boats, nearly all artillery-guns would gradually have to stop production about 1-3 months after the date mentioned, having used up all reserves: Speer Document (Flensburg), November 12th 1943. Imperial War Museum D-FD 2690/45 (11) (G2), translated from German; Alfred E. Eckes Jr. (1979). *The United States and the Global Struggle for Minerals*. Austin and London: University of Texas Press, p. 116.

66 Milward, A. S. (1967). *The German Economy at War.* London - University of London: The Athlone Press, p. 13; Moulton-Marlio, *op. cit.*, p. 23.

67 Einhorn, M. (1962). *Die* ökonomischen *Hintergründe der faschistischen deutschen Intervention in Spanien 1936-1939*. Berlin: Akademie-Verlag, p. 204.

68 Carmona Badía, X. (2003). La minería española del wolframio, 1936-1954: los años de la fiebre. In Glicerio Sánchez Recio and Julio Tascón Fernández (Eds.), *Los empresarios de Franco. Política y economía en España 1936-1957* (pp. 261-280). Barcelona: Crítica-Publicaciones de la Universidad de Alicante; Carmona Badía, X., Nadal Oller, J. (2005). *El empeño industrial de Galicia. 250 años de historia, 1750-2000*. Fundación Pedro Barrié de la Maza;
García Pérez, R. (1994). *Franquismo y Tercer Reich. Las relaciones económicas hispano-alemanas durante la Segunda Guerra Mundial*. Madrid: Centro de Estudios Constitucionales; Catalán, J. (1995). *La economía española y la Segunda Guerra Mundial*. Barcelona: Ariel; Grandío Seoane, E., Zone, W. (2012). *La Segunda Guerra Mundial en el noroeste la Península Ibérica.* Madrid: Eneida; Rodríguez Pérez, J. A. (1985). A minaria do volfrámio em Galiza (1887-1960). Umha primeira aproximaçom. *Agalia. Revista da Associaçom Galega da Lingua*, (2), 49-70; Rolland, E. (2006). *Galicia en guerra. Espías, batallas, submarinos e volframio: do desfile da Wehrmacht en Vigo á fuxida dos criminais nazis*. Vigo: Xerais; Cabana Iglesia, A. (2017). Casi todo era negro: resistencias y puntos de fuga en torno al tráfico ilegal de mineral (Galicia, 1939-1945). *Cahiers de civilisation espagnole contemporaine. De 1808 au temps présent*, (18), 1-18.

But the cutting of supply lines was not immediate and even in 1942 Germany was able to receive 1,000 tonnes from the Far East by sea via blockade-runners[69], although this route had become less and less successful as the effectiveness of the Allied blocked increased. So Germany had to resort to the use of submarines, with much lower cargo capacity than their merchant vessels and involving crossings whose outcome was much more variable[70]. Thus from late 1941 and 1942 Germany's principal source for tungsten procurement became the largest deposits of the mineral in Western Europe, those located in Portugal and Spain[71]. This allowed the Germans to fulfil their essential procurement needs. However, the fact that in accessing the Iberian market Germany suddenly came into competition with the Allies meant that purchasing levels were lower than would have been desirable, which entailed continued depletion of the wolfram stocks available to the German war industries. Whereas before the outbreak of war the country had been able to build up three-year stockpiles of tungsten-alloy steel (as well as other strategic minerals) and take full advantage of them during the first years of the war[72], Blitzkrieg and the intensive use of these resources had depleted the reserves, which could not be restored to previous levels[73], as can be seen in the following two tables:

Table 4. Germany's tungsten supplies and consumption during 1939-1941 (in thousand of tons)

	1939	1940	1941
Consumption	4.2	3.7	3.4
Annual addition to stock	2.7	0.9	1

Source: United States Strategic Bombing Survey (USSBS). (1945). *The Effects of Strategic Bombing on the German Economy.* Washington: Government Printing Office, p. 264.

Table 5. German wolfram stocks (1939-1944) in tons

1939 (3rd quarter)	1940	1941	1942	1943	1944	1944 (3rd quarter)
5,506	5,006	3,058	2,700	1,640	1,457	1,360

Source: Statistische Schnellberichte zur Kriegsproduktion: Jahresheft 1939-1945, [Quick Statistical Reports on War Production: Annual Issue, 1939-1945], Speer Documents (Hertford Series), Imperial War Museum, IWM-D FD3039/49, Section III/98, p. 23.

All this led Germany to begin to rationalise its use of tungsten in the production of anti-tank armour-piercing shells, from at least 1943[74]. In fact, only the production of 5cm calibre shells –able to pierce the armour of the heavy Russian tanks– and one other type was permitted[75]. Ex-

69 Leitz, *op. cit.,* p. 177, n25.

70 Brice, *op. cit.*

71 This was, as we have seen, merely to revert to the norm established both by Germany itself and the Austro-Hungarian Empire, France and Great Britain, during the First World War: the purchasing of wolfram in Spain and Portugal, which had incidentally brought about the first boom in wolfram production in the two Iberian countries. On Spanish tungsten during First Wolrd War, when its price rose from 2,535 pesetas per tonne in 1913 to 8,400 in 1917 v. Leonardo Caruana de las Cagigas-Eduardo González Calleja, "La producción….." cit., p. 190.

72 Wright, *op.cit.*, p. 55.

73 Milward, *op. cit.,* p. 48.

74 Late in 1943 Germany made other important strides to conserve tungsten by use of carbide cores in armour piercing projectiles: Eckes, A. E. Jr. (1979). *The U.S. and the Global Struggle for Minerals*. Austin: University of Texas Press, p. 116.

75 Milward, op. cit., p. 105.

perience had shown that such 5cm shells were just sufficient to pierce the armour of the heavy Russian tanks. It appears that the most advanced and modern panzers –such as the Tiger– used shells able to perforate the Joseph Stalin-class Russian tank plating[76]. With the exception of these two shells, production of all other carbide-core calibres was stopped and all stocks were recalled to provide several tons of tungsten for machine-tool tips[77]. These were irreplaceable.

Furthermore, it appears that Germany was prepared for the cessation of imports from the Iberian Peninsula. From 1943, it reduced its monthly consumption from 170 tons to 100[78], which ensured reserves would last for between 17 and 40 months. Other measures taken to mitigate the loss of mainland imports were, in 1944, the exploitation of Germany's own very low-quality mines, which yielded 35 tons in August 1944; the use of the French mines mentioned above, also poor; and a plan to increase transport of the mineral from Asia by U-boats[79]. Nevertheless, despite never really running out of supplies, Germany suffered from the reduction in the production of shell tips that we have mentioned. It appears that one of the substitutes that was used instead of wolfram carbide at one stage –if the memoirs of former Minister of Armaments Speer are to be believed– was uranium[80].

The rationalization of the use of tungsten should be seen within the context of processes of simplification, reorganization, arms standardization…

The rationalization of the use of tungsten should be seen within the context of processes of simplification, reorganization, arms standardization, improvement in the distribution of raw materials, increased automation, wastage reduction, the concentration of factories producing the same product –all without compromising quality–[81] measures implemented first by Minister Funk, and later, in a more systematic and efficient manner, by Speer, Minister of Ammunition. Even though the US believed the minimum amount of tungsten needed by the German economy was 3,500 tonnes[82], it is clear that they were able to work with less[83]. A critical shortage of tungsten never occurred[84].

As we have mentioned, the Allies' pre-emptive purchase of Portuguese[85] and Spanish wolfram ore played an important role in diminishing the amounts obtained by Germany. In Portugal, the

76 Caruana, L., & Rockoff, H. (2003). A Wolfram in Sheep's Clothing: Economic Warfare in Spain, 1940-1944. *The Journal of Economic History 63*, 1, 118.

77 Milward, op. cit., 105.

78 Leitz, op. cit., p. 196. A reduction from 170 to 120 (30th July 1943) and from 135 to 100 (1944) see *Ibidem*, p. 195.

79 *Ibid*., 194.

80 Speer, A. (2001). *Memorias*. Barcelona: Acantilado, p. 420. Depleted uranium is used as a substitute for tungsten in shells today, due to the fact that it also possesses extremely high density and hardness; however, depleted uranium catches fire inside tanks and causes contamination, while tungsten shells pierce without catching fire. Like tungsten, uranium is also used to manufacture tank armour. http://www.portierramaryaire.com/arts/proyectiles_tanque_2.php

81 Overy, R. (1994). *War and economy in the Third Reich*. Oxford: Clarendon Press, p. 343.

82 Requirements: The insurmountable minimum of German tungsten requirements for industrial uses is estimated at 3500 tons of concentrates. Any tungsten possessed by Germany in excess of this amount may be diverted to the production of tungsten carbide cores for armour-piercing projectiles: Telegram American Embassy (London) to Secretary of State. November 16th, 1943. RG 234 Records of the Reconstruction Finance Corporation. United States Commercial Corporation. Field Preclusive Operations. File 1942-1945. National Archives and Records Administration (NARA-2).

83 Imperial War Museum IWM-D FD4733/45, p. 30, quoted in Eric Bernard Golson, The Economics of Neutrality: Spain, Sweeden and Switzerland in the Second World War (Ph d Diss, Department of Economic History, London School of Economics and Political Science, 2011), p. 192.

84 Zilbert, E. R. (1981). *Albert Speer and the Nazi Ministry of Arms. Economic Institutions and Industrial Production in the German War Economy*. London: Associated University Presses, p. 39.

85 Most wolfram deposits in Portugal are located to the north of the country, next to the north-west and eastern borders with Spain.

largest European tungsten producer[86], the Allies always received greater quantities of exports than Germany, as shown in this table:

Table 6. Exports of Portuguese wolfram concentrates (65 % wo3) (tons)

	1940	%	1941	%	1942	%	1943	%	1944	%	1940-44	%
To Germany	185,2	5,4	1814,3	34,7	2168,9	45,2	1342,3	20	701,4	27,2	6212,2	27,2
UK	1782,9	51,8	2363,3	45,1	2589,4	53,9	5321,4	80	1986,9	73,9	14043,9	61,5
USA	768,4	22,3	847,7	16,2							1762,1	7,7

Source: Comércio Externo quoted in Joao Paulo Avelas Neves (2010): *O Estado Novo e o Volfrâmio (1933-1947)*. oimbra: Imprensa da Universidade de Coimbra, p. 392.

In fact, Germany did not enter the market for Portuguese wolfram until the defeat of France, but very quickly, in only six months, it had succeeded in establishing itself and taking a prominent position within it. Its presence would continue from then on until the market was closed, in mid-1944[87]. But in Portugal –just as in China and Spain– there was also a black market. In the two Iberian countries, it was organised by the two opposing sides; and in the case of the wolfram intended for Nazi Germany, it benefited from the covert participation of both Portuguese and Spanish authorities. In Portugal the trade was linked to the secret acquisition of German heavy weaponry[88] by the *Estado Novo*, involving nominally private companies that were in fact German, such as Minero-Silvícola Lda (with its head office in Lisboa); the Sociedad Financiera e Industrial SOFINDUS (with its head office in Madrid); and the Rohstoff-Waren-Kompensation Handelsgesellschaft ROWAK (with its head office in Berlin)[89]. Wolfram was also smuggled between Portugal and Spain, a trade driven by the higher prices paid in Spain, where purchases were tax-free, whereas in Portugal they were taxed[90].

Table 7. German and Allied exports and sales of wolfram in Portugal (tons)

Wolfram production (tons)				
Year	Anglo-American Mines	German Mines	Free Mines	Total
1942-1943	2,906	1,080	1,112	5,098
1943-44	4,009	904	1,304	6,217
Wolfram Exports (tons)				
Year	To Anglo-America	To Germany	German Share (%)	
1942-1943	3,184	1,915	37	

86 Li-Wang, *op. cit.*, p. 419.

87 Avelas Nunes, J. P. (2010). *O Estado Novo e o Volfrâmio (1933-1947)*. Coimbra: Imprensa da Universidade de Coimbra, p. 393.

88 *Ibidem*, p. 418.

89 *Ibid.*, p. 419-420.

90 José Miguel Ruiz Morales (1946). *La economía del bloque hispano-portugués*. Madrid: Instituto de Estudios Políticos, p. 234; António José Telo (1991). *Portugal na Segunda guerra mundial (1941-1945)* (vol. 1). Lisboa: Editorial Vega, p. 214-215; Leitz, *op. cit.*, p. 171, n4.

1943-44	4,660.5	1,535.5	25.02	
Wolfram Trade with Germany (tons)				
Year	Quota in Agreement	Actual Exports (tons)		
1942-1943	2,400	1,915		
1943-44	2,100	1,535.5		

Source: Mapas references ao wolfrâmio e notas elucidativas. Ministério dos Negócios Estrangeiros, March 9, 1944 cit. in Melissa Teixeira (2008). *Caught on the Perifery: Portuguese Neutrality during World War II and Anglo-American Negotiations with Salazar,* Senior Thesis, University of Pennsylvania, p. 137.

In contrast to Portugal, in Spain[91] Germany was able to purchase and export more wolfram than the Allies until 1942. Later, during 1943, Germany was overtaken. But in 1944, thanks to smuggling, Germany was able again to export more mineral than the UK and the USA, as shown in this tab

Table 8. Relative success of Allied pre-emptive buyings in Spain (1941-1944) (tons)

Year	Spanish Wolfram ore production (content Wolfram 60-65 %)	German exports/acquisition	Allied exports /acquisition	Prince
1941	503.6	318/800	20/72	Between 2,590-65,000 pes/ton
1942	1,475.5	794/805	438/771	Between 125,000-160,000 pes/ton
1943	3,618.7	834.3/1,309	943/3,021	Between 170,000-275,000 pes/ton
1944	-	843,6 tons exported during 1944 according to German sources/ without figure acquisition, but 1,031 tons stockpiled in August 1944, which had failed to be exported, or a minimum of 970 exported during 1944 according to the estimate of Joan Maria Thomàs or 970, plus 1,031 stockpiled 336/1,088	336 until April 7/ of 1,088 acquired until April or 336.6 of 540.9 acquired during January and February	180,000

Source: Reproduced from Leitz, *Economic Relations*…cit., p. 176 with the quantity (970) calculated by Joan Maria Thomàs. The figures marked with an asterisk correspond to those found in the United States Commercial Corporation document "Wolfram and Scheelite Acquired in Spain from USCC-UKCC Joint Account", March 20, 1944. Hayes Papers. Table 8 is reproduced from Thomàs, *op. cit*., 124.

As regards smuggling, in Spain too, it was tolerated –and even encouraged– by some in authority, even by some ministers, as it seems may have been the case with the Minister of Commerce and Industry, Demetrio Carceller Segura[92]. In fact, even during the "Battle for Wolfram" mentioned above, which meant that from January to May 1944, due to Allied pressure, Spain was forced to suspend tungsten exports to either side, it continued to be sold and the covert

91 Spain's wolfram deposits are mainly concentrated in the northwest (Galicia and the northwestern provinces of Castilla) and the west (Extremadura), all of which areas are within provinces that border Portugal.

92 About this question see Thomàs, *op. cit*., p. 132.

transportation of wolfram ore to Germany continued to be allowed, although in lower quantities than the Nazis would have been able to obtain under normal conditions.

The result of the "Battle" was a huge reduction in the amount of wolfram that Spain sold to Germany and the Allies (even though, as we know, the Allies did not need it), together with the discontinuation of Portuguese wolfram exports ordered by the Salazar government one month later, in June 1944. This was accompanied, to the detriment of Germany, by the gradual retreat of its troops from French territory as the country was liberated by the Allies and the Résistance, with the resultant loss of the overland transport route between the two countries via France. Altogether this entailed an almost complete halt of the entrance of Iberian wolfram into the Third Reich. During the second half of 1944 and the first months of 1945 only very small amounts would arrive from the Iberian peninsula, whether by air or by submarine, which were joined by small quantities arriving from the East in U-boats. The end result was that, until its defeat, small amounts of tungsten were still available to Nazi Germany, meaning that it did not have to suspend production of two kinds of anti-tank grenade, or the manufacture and use of some essential components of indispensable machine tools, although in quantities far less than those the country's war industries required –and in fact had had during the first phase of the conflict–.

The specific characteristics of wolfram meant that the Great Powers built up strategic stockpiles during the inter-war period, in case of new conflicts

4. Conclusion

Wolfram/tungsten was not by any means the most important strategic material among those used by the principal combatants in the Second World War. Neither in terms of the quantities in which it was used (amply exceeded by other materials, such as oil and rubber products) nor of its indispensability –in which sense it was surpassed by chrome, tin and aluminium, among others–. However, tungsten was essential in the manufacture of some machine tool components, in increasing the piercing/destructive power of certain types of shell, and in strengthening armour.

The specific characteristics of wolfram meant that the Great Powers –who had used it during the Great War– built up strategic stockpiles during the inter-war period, in case of new conflicts. This began with Nazi Germany –the aggressor power par excellence during the last two years of the 1930s and the first half of the next decade– which bought tungsten from China between 1936 and 1939. As did the Soviet Union between 1938 and 1941, and even after this date. For its part, the United States, which had deposits within its own territory, nevertheless worked to stockpile reserves, acquiring wolfram from China, India, Portugal and Spain[93]. The United Kingdom had large quantities in its Eastern colonies, in Burma and Malaya. Japan, which had none within its own territory but in territory it had annexed, the Korean peninsula, stimulated and increased extraction of the mineral while at the same purchasing it in China –first legally and then, after its invasion of the country in 1937, illegally– as well as in Hong Kong and other colonies until 1941. The Japanese also had plans –which they would eventually carry out– for a future conquest of the rich deposits of raw materials in the Dutch East Indies, Burma and Malaya. Wolfram was not their overriding objective –rather it was oil and rubber– but it was still an important one.

93 Marshall, *op. cit.*, p. 33 and following.

When war broke out in Europe on 1 September 1939 there was no indication of what would eventually happen in Nazi Germany: a progressive and significant decline in its tungsten reserves, stockpiled over the three preceding years, which would force a reduction in its use. In fact, the Germans had found abundant reserves of raw materials in the countries it conquered during the first years of the war, and in particular, in France, wolfram mines. Furthermore, until 1941 the Germans received wolfram from China, thanks to the agreements with the Soviet Union and Japan. But during the second half of 1941 things were to change. By attacking the USSR, Germany lost it as a source of tungsten supplies and as an overland link to China. At the same time, China broke off relations with Germany after this attack.

From this time onwards, Germany depended primarily on wolfram from Portugal and Spain – where it had been purchasing it since 1936, in smaller amounts. They were friendly dictatorships but in this matter their actions were markedly opportunistic[94], placing their own interests first and allowing competition for the mineral between Germany, the United Kingdom and the United States. This represented a lucrative trade for both Iberian states and for many private interests, including senior figures within their respective governments. This competition resulted in the Germans obtaining smaller quantities than would otherwise have been possible, which contributed to the depletion of their reserves and a restriction of the use of wolfram to two specific calibres of shells and essential machine tool parts.

The United States, immediately after being attacked by Japan in December 1941 offered to purchase the entirety of China's tungsten output

As for Japan, after Pearl Harbor, it effected the eagerly awaited conquests of British and Dutch colonies on the Asian continent and its islands, but proved to have limited ability to take advantage of tungsten deposits that retreating armies had rendered unusable. This was compounded by their patchy and imperfect control of sea routes between conquered areas and the Japanese mainland, besieged by Allied naval forces and aviation. It thus had to depend mainly on the exploitation of Korean wolfram, which it increased, as well as on smuggled Chinese tungsten.

For its part, The United States, immediately after being attacked by Japan in December 1941, made a great leap forward in its raw material procurement policies. In the case of tungsten, it offered to purchase the entirety of China's tungsten output, which it in fact went on to do over the years that followed. But from the outset, it encountered great difficulties in extracting the mineral from China, given that the speedy Japanese victories in Burma closed off the Burma Road and sea routes to the West. In order to surmount these obstacles, the US came up with the idea of an airlift –the Hump– which for three years would carry wolfram and other minerals from China to India, using the same aircraft to carry military supplies on the return trip. When it arrived in India, and then the United States, the tungsten was distributed among their own war industries and also to those of the USSR and the United Kingdom. These Allied countries thus came to depend almost entirely on the United States for their procurement of wolfram.

Furthermore, the US government stimulated production in their own tungsten mines, vastly increasing the volume being extracted, whilst also diversifying their purchases to other producer countries in the western hemisphere including Bolivia and Argentina. The result was a build-up of reserves and a level of use on scale that was unheard-of, especially in the United States, but also in general on the Allied side. These levels of use stood in contrast to those on the Axis side, where they were falling. Germany was suffering from the depletion of its reserves and had to ration its use of the mineral to maintain production of what was strictly essential, while Japan

94 See Golson, *op. cit.,* p. 465.

saw its own wolfram shortage become chronic, and eventually was able to cover only 65 % of its needs.

In view of all this, it seems plausible to conclude that the unequal distribution both of tungsten production and the accumulation of tungsten reserves during the Second World War was a factor that contributed to the Allied victory. In no sense was it a decisive factor, but it was important, given the usefulness and effectiveness of the weapons it was used to manufacture, and its use in war industries in general. For Nazi Germany, during the last years of the war, the decisive factors would in fact be the collapse in synthetic oil production, the breakdown in overland communications, and the destruction of important industrial areas, such as the Ruhr, by Allied aviation. These derived from two principal causes, Allied air supremacy and the devastating attrition and losses among land forces on the Eastern front[95]. Equally decisive, in this case in the Japanese defeat, was the collapse of maritime communications.

Unequal distribution both of tungsen production and the accumulation of tungsten reserves during the Second World War was a factor that contributed to the Allied victory

The Allies invested a great deal of energy and money in achieving a reduction in German procurement of wolfram in Iberia, via preventive purchasing, and, during the last year of the war, by initiating the "Battle for Wolfram" in Spain. They also succeeded in obliging Portugal to suspend its sales to both sides, all this in mid-1944, in other words at a late stage in the conflict, when the final outcome was becoming clearer and clearer. And in fact, the United States, after resolving the wolfram question, exerted pressure to interrupt the sale of other vital raw materials to the enemy –Turkish chrome, Swedish iron and Swiss products–. Again, they were successful. It was the last year of the war and Allied victory was already in sight. Even so, until that time, opportunism, cronyism and self-protection –all of which were present to different degrees in the relations between Neutral countries and Germany– were constant themes, and the ongoing procurement of strategic minerals a tangible reality.

At the same time it is worth pointing out that the procurement of raw and strategic materials to build up stockpiles sufficient for prolonged warfare never occupied the first place in Hitler's calculations. This was not the case with other German strategists (both military and civilian), who were concerned about the country's lack of preparation in this respect. The Fuhrer, by contrast, never foresaw warfare of this nature, instead short, lightning-fast wars –*Blitzkrieg*– with the possible exception of the great war he intended to wage in the future against the 'mongrel' nation par excellence, the United States[96]. He intended to initiate this war a few years after the defeat of the USSR, a defeat he imagined following a short campaign –like the defeat of France– but in this calculation he was wildly incorrect. In the end, he would be defeated by a combination of the human potential of the Soviets and the vast North American arsenal, an arsenal that was based, to a large extent, on resources possessed in greater abundance by the Allies than by the Axis. And these included wolfram/tungsten.

95 Overy, R. (2005). *Por qué ganaron los Aliados.* Barcelona: Tusquets.

96 Norman J. W. Goda (1998). *Tomorrow the World. Hitler, Northwest Africa, and the Path towards America.* College Station: Texas A&M; Gerhard L. Weinberg (1994). *A World at Arms: A Global History of World War II*. Cambridge: Cambridge University Press.

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