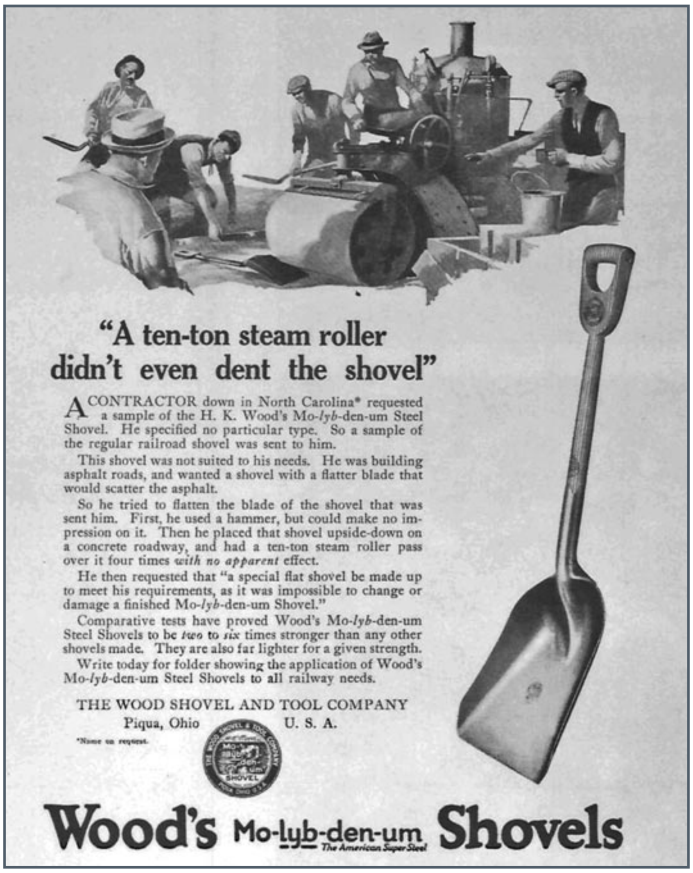
Molybdenum, metallic mystery: a brief history

For centuries, molybdenum was confused with lead and graphite until scientists finally isolated the element in 1781. It came into commercial use during World War I as a steel hardening agent. In the century that followed, hundreds of uses and functions of molybdenum have been uncovered, from corrosion resistance in stainless steels to an essential role in human health.

Around 90 chemical elements are found in nature, including molybdenum, which occurs in compound minerals called molybdenite, wulfenite, and powellite. By far the most common of these is molybdenite, a greasy, silver-gray mineral that leaves a mark on paper. Molybdenite was known and used in ancient times, but it was unclear if it was just another ore of lead or graphite. The element's challenging name comes from "molybdos", meaning lead-like in ancient Greek.

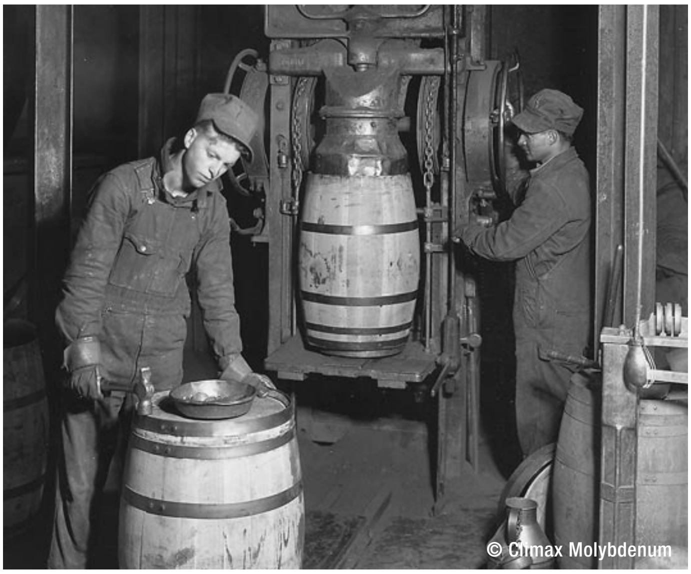
A misnamed mineral

It wasn't until the end of the 18th century that molybdenum was consistently distinguished from lead and graphite. In 1754, mineralogist Bengt Andersson Qvist analyzed a sample of molybdenite and found that it did not contain lead. 20 years later, the renowned chemist Carl Wilhelm Scheele built on this finding with a landmark discovery. In 1778, he proved that molybdenite was a sulfur compound of an unidentified element. Three years later, another chemist, Peter Jacob Hjelm, isolated an impure form of molybdenum at Scheele's suggestion, using carbon and linseed oil. Hjelm named the element "molybdenum" for the mineral ore in which it was found. It was not used commercially for another 100 years, until metallurgists found it could harden steel similar to tungsten in 1891. That year, French company Schneider & Co. debuted plate steel alloyed with molybdenum for armored vehicles.



Molybdenum-alloyed steel shovels provided strength for demanding road and rail work. © Climax Molybdenum

Around the same time, Norwegian peasants discovered a rich deposit of molybdenite near Knaben in the south of Norway and began mining it by hand. They used what they called "pencil rock" as a lubricant and stove polish, and established molybdenum's first commercial valuation at one pound of molybdenite for a pound of butter. Scientists began studying the ore in earnest and demand increased enough that two additional mines opened at Knaben in 1895.



Historic view of workers packaging molybdenum concentrate in barrels for shipment to customers.

From obscurity to mass use

Despite the discovery that molybdenum could harden steel, establishing demand for the then-little-known element was a challenge. Two major events changed this. First was successfully developing an economical way to separate molybdenite from rock – a flotation process still in use today. The second was the outbreak of the first World War.

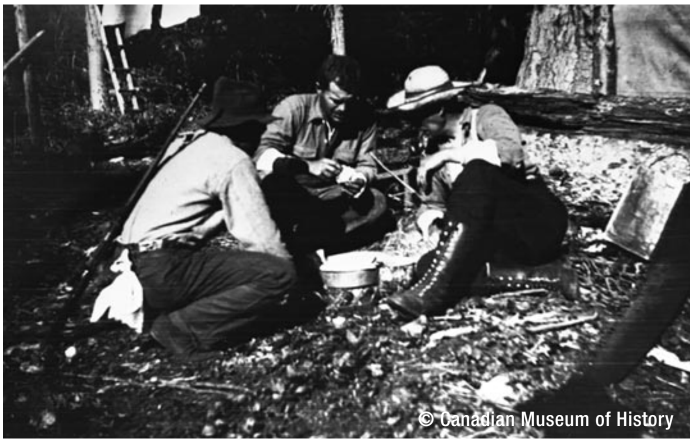
Before molybdenum, tungsten was a key element used to harden steel, critical for tank bodies and other defense machines. World War I squeezed the global tungsten supply, leading to its substitution with molybdenum. Demand soared. Now miners at Knaben were trading a pound of molybdenum for three pounds of butter.

Peacetime drives new applications

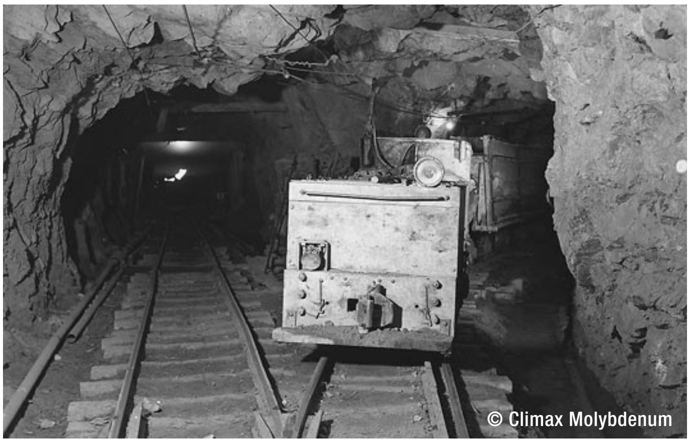
Want for molybdenum retracted after the war. At the time, mining companies did not promote new uses for their products – they simply met existing demand. That changed when another early mine, Climax in the US, began donating molybdenum to any steel company willing to experiment with it. The conservative American steel industry took little interest. Then the mine turned to the automotive industry, where they met renowned metallurgist, C.H. Wills. Wills was instrumental in developing the Ford Model T, the first automobile affordable to the masses. He left Ford looking to design a lighter and more-fuel efficient vehicle without compromising durability. The alloy Wills chose to offer this superior performance was molybdenum-alloyed steel.

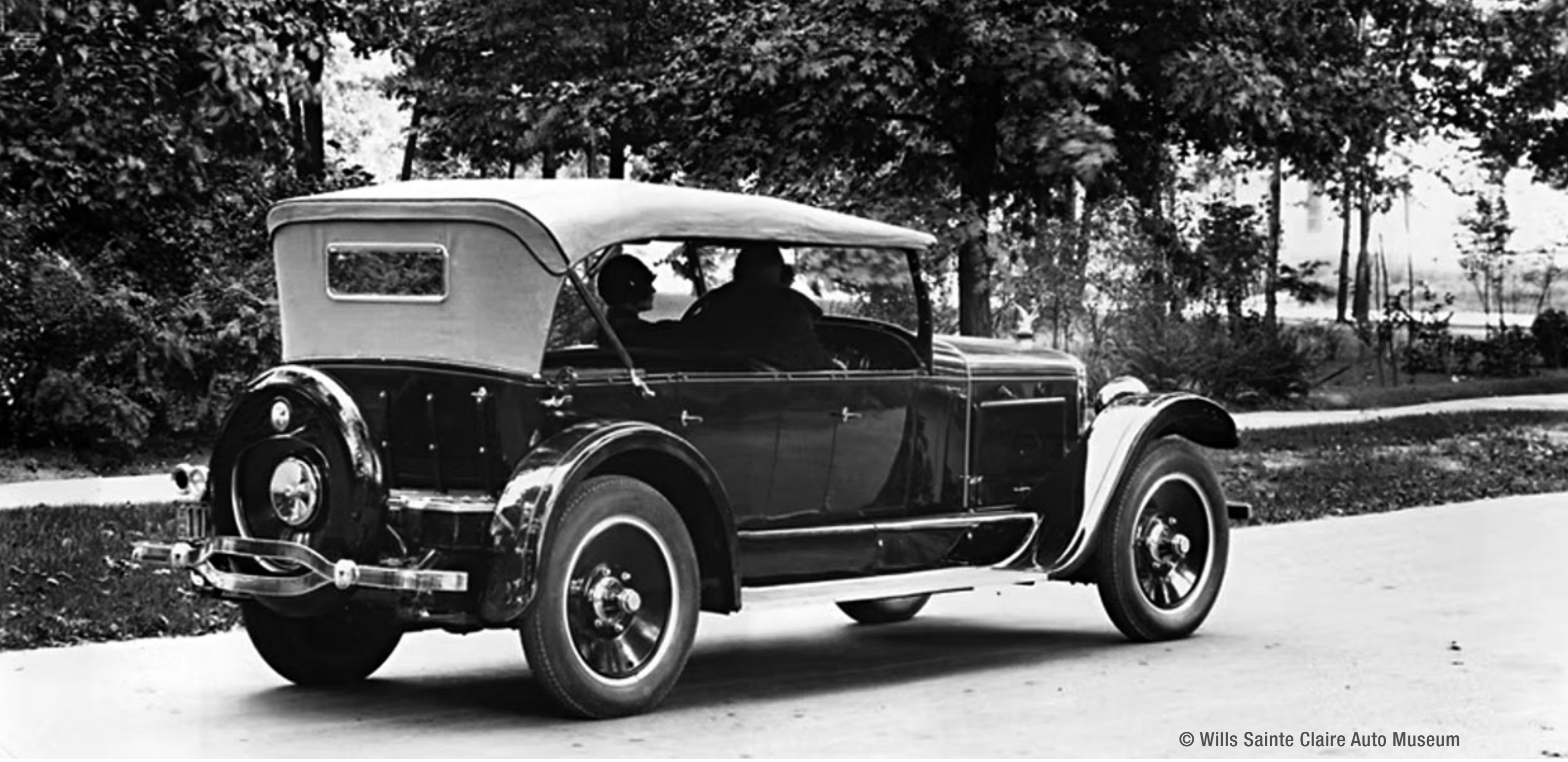
The "Gray Goose" was unveiled in 1921. The vehicle became the reason molybdenum gained widespread acceptance as a beneficial alloying element in steel. Every component of the car's engine, power train, frame, and suspension that encountered stress was made from a molybdenum-containing alloy. The cars competed in the extremely popular coast-to-coast races of the 1920s and were often the only automobiles to finish. This served as an advertisement for molybdenum's ability to make steel more durable. By the mid-1920s, major automakers and steelmakers began ordering molybdenum in quantity. It also gained acceptance by government and industry agencies as a standard industrial alloying element.

Researchers and prospectors studying ores in 1918 in British Columbia.



Early mine locomotive hauls ore cars from deep underground to processing facilities.





The Wills Sainte Claire "Gray Goose", produced from 1921 to 1926, won many cross-country races, thanks to its molybdenum-containing construction materials.

Discoveries expand

Following the Gray Goose's success in 1921, engineers expanded molybdenum's use into more demanding environments. It's role in aviation had already begun during World War I, when chromium-molybdenum steels were used in aircraft frames for their strength-to-weight advantages. Molybdenum's ability to retain strength at high temperatures made it ideal for early aircraft engines, particularly in hot exhaust components. By the early 1930s, it was alloyed into stainless steels, giving rise to Type 316, a grade with exceptional resistance to pitting and crevice corrosion. This new alloy was soon adopted in marine and chemical equipment as well as food processing.

While its industrial applications were growing, researchers were also uncovering molybdenum's biological importance. By 1932, several researchers had described the occurrence of molybdenum in plants and animals, as well as its possible functions. This began a journey of understanding its role as an essential trace element for most living organisms, and led to other uses, including fertilizer additives.

World War II renewed strategic demand for molybdenum in armor plate, artillery, and high-temperature steels. After the war, these materials transitioned into peacetime industries. Molybdenum became vital in tool steels and high-speed steels, where it formed stable carbides that preserved cutting edges at high heat. Through the 1970s, molybdenum was widely used in high-strength low-alloy (HSLA) steels, making gas pipelines, bridges, and heavy machinery stronger yet lighter. At the same time, molybdenum-bearing stainless steels became standard in nuclear power and pharmaceutical processing – anywhere corrosion resistance was essential.

Since the 1980s, molybdenum has supported advances in energy, transportation, and infrastructure. It became indispensable in superalloys for jet engines and gas turbines, in corrosion-resistant grades for oil, gas, and chemical processing, and in catalysts used in cleaner fuel production. Molybdenum disulfide gained wide use as a dry lubricant in aerospace and industrial machinery. As industries move toward higher performance and lower emissions, molybdenum plays a growing role in wind turbines, solar thermal power plants, and ultra-high-strength steels for automotive safety and weight reduction. It also remains critical in oil country tubular goods (OCTG) and hydropower infrastructure, where strength, corrosion resistance, and durability are essential.

History in the making

Today, molybdenum is primarily mined as a by-product of copper mining, though some mines focus exclusively on molybdenum extraction. China is the world's largest producer and user of molybdenum and possesses the greatest known reserves. Chile, Mexico, Peru, and the US are other major miners, and hold the largest reserves behind China. Molybdenum research is now a worldwide affair, so developments happen at a much quicker pace than in the previous century.

Though steel remains the largest market for molybdenum, applications continue to diversify. Now molybdenum plays a role in everything from lighting to semiconductors, energy production, fertilizers, infrastructure, architecture, and medicine. Its history continues to be written as new findings unfold with relentless speed – and its greatest impact may still lie ahead. (Karlee Williston)