METALLURGY

Mining a Mountain

Bartlett Mountain, in Colorado, Once Cursed Because It Held No Gold, Now World's Chief Molybdenum Source

By RONALD L. IVES

THERE wasn't any gold in Bartlett Mountain. Miners found only a shiny black mineral that contained sulfur and something else whose name they couldn't even pronounce. They cursed Bartlett Mountain with colorful vehemence, and moved on to other mountains, where there was more gold—they hoped.

Today, when most of the gold and silver mines in the Leadville area are closed down, or worked out, Bartlett Mountain is trembling with activity. That "useless" black mineral on which the prospectors turned their backs makes this one of the most important mountains in the world. It insures that no matter what happens, American automobiles will have flexible springs, our airplanes strong wings, our warships tough armor and powerful guns. For it is the ore of molybdenum, one of the most important of all alloying agents used in the making of modern steels.

Three-quarters of the world's supply of "Moly," as it is nicknamed for short, comes from this one mountain. They are tearing 10,000 tons of the ore out every day now, and there is more than 160,000,000 tons of it still in the mountain—how much more, nobody knows.

It's Hard to Say

Miners still can't pronounce that word, molybdenum. (Well, can you, either, at first try? Mo-*lib*-d'num—that's about it.) Locally, it came to be known as "Molly-bend-um," and the miners are still referred to as Molly-benders—when they aren't within hearing.

Moly is a peculiar metal. Until a few years ago, it was just a chemical curiosity, mentioned in the books, but not used for anything. It is still worthless—by itself. Only when it's alloyed with other metals is moly worth anything, but then it's so valuable that the crude mineral, molybdenite, sells for almost half a dollar a pound. It's something like the yeast used in baking. Yeast is not very edible, and not very expensive, but added to dough before baking it changes hardtack to bread.

Moly, as it comes out of the mill for shipment, doesn't look very spectacular. Almost anyone would mistake it for graphite. Pioneers tried to use it for greasing axles, but it didn't work very well. When it's heated, moly smells like burning sulfur. Later, after refining to calcium molybdate, it is a whitish or grayish powder, looking like pulverized plaster-of-Paris. Steelmakers prefer the calcium molybdate, or an alloy of moly and steel, to the crude ore, because the sulfur in the ore makes steel "short," or brittle.

Everything Different

Even the ore body at Climax is different. Most ores occur in veins or blanket deposits, with definite boundaries. At Climax, the molybdenum ore is found in an inverted cone within the mountain, with the workable mineral at the outside. Inside of the rich zone, which contains seven or eight pounds of molybdenum sulfide to the ton, is a zone of leaner material, which cannot be profitably mined, while on the outside the molybdenum values fall off gradually until the ore is not worth mining.

Chemists, analyzing the ore daily, tell the hard-rock men just how rich, or how lean, the ore is in a given bore. Then, as they prepare for the blasts, they can tell just how much ore is worth breaking down. Too much lean ore will make the mill run at a loss, too little lean ore leads to wasteful mining, and depletion of the reserves.

Mining is always hard work, but mining the weirdly-shaped ore body at Climax is particularly difficult. There is one-third less air to breathe at two miles above sea level, and the mountain winters are long. Men tend to "burn out" at high altitudes, and tempers become short toward the end of a long mountain winter. Mechanized mining, high wages, and excellent living conditions offset most of the troubles due to altitude, but not all. Sun lamps, installed to give the men their quotas of ultraviolet light during the long winter season, are the latest move to keep the men well.

A ton of molybdenum ore has only a few pounds of molybdenite, the valuable mineral, in it. Hence, the ore is not worth more than the value of the moly in it, and this is only three or four dollars a ton. Out of these few dollars must be paid the cost of getting the ore out of the mine, the cost of getting the mineral out of the ore, and the general expenses of the mine, such as interest, taxes, repairs, etc. If there is anything left over, that will be the profit.

In a great many mines, it costs from $3 to $10 a ton to get the minerals out of the ore. This exceeds the value of the Climax ore, so special methods had to be worked out. Today, by using these, the ore is handled at a cost of about $2 a ton. This leaves from $1 up to pay the tax collector, and the stockholder, and the repairman, and to care for the thousand and one other expenses of a mine.

Getting the ore out cheaply necessitated large-scale operations. They don't blast every day at Climax—they blast once or twice a year. A few years ago, Climax hard-rock men worked almost a year preparing for one blast, then shot 110,000 pounds of explosives all at once, bringing down three-quarters of a million tons of ore. The shock of the blast was felt in Denver, across two ranges of mountains from Climax.

Blasts Without Fuses

Perhaps you will visualize some grizzled mining foreman running around through miles of workings under Bartlett Mountain, lighting each carefully-measured fuse with his miner's lamp, then running on to the next, and finally, after an hour's hectic work, dashing madly out to shelter just before the first blast let go? It's a romantic picture, but it didn't happen. The big blasts at Climax are fired electrically, and aren't very spectacular to the average person. A dull rumble and a trembling of the ground are all that can be noted immediately, then a few puffs of powder-smoke from cracks in the mountain's flanks.

Local legends tell of a warning call to the seismologist in Denver, so that he can guard his seismograph against the sudden shock of the blast, which resembles a minor earthquake. After the blast, which is only one step in the mining operations, the air in the bowels of Bartlett Mountain slowly clears of the powder fumes, and men go in to remove the blasted-down ore.

It's a long step from the hand-steel-and-black-powder methods, with manual loading and mules for hauling the cars, to the present big blasts, power loading and electric haulage, but the new methods made moly mining profitable instead of prohibitively expensive. After the blasts inside the mountain, the ore is dragged by machine to a chute, down which it slides into cars holding about ten tons each. A thousand carloads a day is now the regular output of the mine. Twenty-five carloads make up a train, which is hauled out to the mill at the foot of Bartlett Mountain, but still two miles above sea level.

Getting the ore out of the mine has now been done—drill, blast, scrape, haul, and it's done. Skilled hard-rock men, powerful machines, careful planning, all are necessary to do the job cheaply, quickly, and safely. The lowest-paid help at Climax get $4.50 a day; many skilled men get more, and the work is very steady.

Tedious Refining

Next begins the wearisome task of getting the molybdenum sulphide out of the ore. In each 2,000 pounds of ore are about seven pounds of sulphide. Unless the ore is treated as fast as it is mined, it will pile up, using space where space is at a premium, and need rehandling. The ore trains dump their loads directly into the mill, and the rock is crushed and ground as the first step in refining. No rock particle may be any larger than the smallest ore particle that should be recovered.

Grinding equipment, which must be economical, and must work thoroughly, is arranged in "closed circuit" with a classifier. Each particle that is ground to the desired smallness is removed by the classifier, while the larger pieces of ore go back to be ground some more. After grinding, the ore, now a gritty muck, goes to flotation cells, where the molybdenite is separated from the unwanted rock by the action of pine oil. The rest is simple—the rock is carried by water to the tailings pond, while the moly goes to a dryer, and then is barreled for shipment.

Mill men at Climax have a problem in economics that never ceases. If they recover all the moly in a ton of ore, it costs more than the moly is worth. If they let some of it go through to the tailings pond, they make a profit, while if too much goes out with the tailings, they again lose money. Careful adjustments of every stage of the milling process keeps the recovery around 90 per cent., which is the most economical value.

A mill man is more than just a machine operator. He must know how to operate the machines, it is true, but any darn fool can learn to do that. A man can study ores for years, gaining several college degrees in the process, and still be no good as a mill man. Great experience, and the development of the trait called "savvy," make a mill man good, and once he is known as a "good mill man" he has no more job worries. Like the highly skilled worker in almost any field, he is always in demand.

Finished in East

Concentrated ore is stored in the local warehouse until ready for shipment, then is hauled eleven miles through the mountains to Leadville, where it is loaded on the standard gauge railroad for shipment to seaports, users, or the company's refinery at Langeloth, Pa., where the molybdenum sulphide is converted into more usable compounds, such as calcium molybdate or ferromolybdenum. These are shipped from the refinery to users.

Roads between Climax and Leadville must be kept open, even when the mountain snows cover the scrawny trees of the timberline zone. One engineer is kept busy continually by the constant battle with mud, snow, sleet, and balky machinery. Ore can wait, if necessary, but supplies for 1200 men, fuel, machine parts, and mine timbers must come to Climax regularly. There must be no delays. The mine and mill must be kept operating at maximum efficiency, each delay or stoppage costing hundreds or thousands of dollars. The transportation engineer's job is just as important and responsible as the boss hard rock man's.

Miners call the narrow-gauge locomotives "teakettles on wheels," but they are designed for pulling heavy loads up heavier grades. Getting there, not speed, is the important factor. Not far from Leadville, in the good old days, when this road was still operating to Denver, a circus train stalled on a heavy grade, and threatened to tie up travel in both directions until the elephants got out and helped push. Soon, according to present plans, a standard gauge railroad will be built into Climax from Leadville, saving the trucking and rehandling costs.

Long Uphill Fight

Moly didn't have a meteoric rise as a steel alloying agent. Twenty years ago it was a curiosity. There was a grim battle with expiring options, skeptical buyers, and balky refining processes, before the mine really went into operation. The early work was done by hand, in the thin air of the high country.

Today, a dozen metallurgists sell the output of the mines. They aren't salesmen in the usual sense. Their job is not to buy drinks for possible customers until they sign the order, but to show what moly will do, and back up their statements with records of past performances. A moly salesman truly has "nothing up his sleeve." He can't have. His job is to sell moly—not just one order, but to

FREIGHT ROAD INTO THE MOUNTAIN

This twelve-foot tunnel into Bartlett Mountain will provide room for a double-track railroad for the more rapid removal of the molybdenum ore.

create new uses for it, uses so valuable to the buyer that he will order moly year after year.

Several other areas in the world are small producers of moly. Climax produced 15,000,000 pounds of concentrates in 1936, the last year for which figures are available. Total U. S. production during the same year was only about 17,000,000 pounds. Mammoth, Arizona, produced a little more than a million pounds of moly concentrates during that year, and the remaining million pounds came from New Mexico, Utah, and Washington. The other 3,500,000 pounds of moly produced that year came from ten different countries.

Wartime use of moly, as a hardener for armor plate, a toughener for cannon, and for lightening aircraft, increases the strategic value of the Bartlett Mountain moly deposits, but their real value is in peacetime industry. Moly is about the only steel-alloying material which is plentiful in the United States, although we are the world's greatest user of alloy steels. When a tougher, or harder, or more temperature-resistant steel is needed, the engineers of the various mills try moly, and often they find that it, or a combination of moly with nickel, or tungsten, or chromium, will do the job. Climax engineers cooperate in these researches.

Twenty years ago, you couldn't sell a ton of moly at a profit. Today, the mines must be worked continually to meet the demand, and they never seem to quite catch up. Will the increasing use of alloy steel, particularly molybdenum steel, bring a new era to metal manufacture? Many engineers think it will.

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READY TO ROLL

Last stage before it starts on its travels: the "moly" concentrate, now practically pure molybdenum sulfide, is packed in stout barrels.

CHEMISTRY

Chemical in Water Stops Corrosion of Iron Pipes

CORROSION of iron water pipes, particularly those carrying hot water, can be markedly decreased by adding a small amount of sodium sulfide to the water to combine with the free oxygen present in it, scientists of the Kaiser Wilhelm Institute have found.

The free oxygen is the substance primarily responsible for rusting the pipes. The substance left by the combination of the oxygen and sodium sulfide is harmless.

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ENGINEERING

Rubber Bearings Used In Underwater Work

ADD RUBBER to your list of unusual materials now being used for surfaces of bearings. Copper, lead, babbitt metal, rarer cadmium and indium, even silver, are the best known members of the bearing family for they all possess special properties of toughness, long wear, corrosion resistance or other desired characteristics. Flexible, yielding rubber seems a strange addition to this bearing family.

And yet, when you study the places where rubber bearings find usefulness the application of rubber is not too surprising. Pumping systems for drinking water and many solutions used in the preparation of foodstuffs or beverages comprise one application. A few others would include: high-speed motor boats, underwater marine work, hydraulic turbines, centrifugal pumps, agitators, washing machines and domestic and industrial liquid-handling equipment.

Secret of rubber's usefulness as a good bearing material is its ability to suffer slight displacements and yet keep a tight fit. Thus a grain of sand or other hard particle only makes the rubber surface give and does not force the particle into the axle, or bearing surface.

As reported to the Institution of Mechanical Engineers in London by Sydney A. Brazier and W. Holland Bowyer, water or other fluid, and not oil, is the lubricant with rubber bearings. A series of slots are provided in the bearing and the fluid passes, rather freely, through these interstices so that it can wash out dirt particles and also remove heat, for rubber's heat conductivity is so low that this factor is a problem in the use of these novel bearings.

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Brook trout bury their eggs in beds of clean gravel in autumn, generally in spring-fed headwater streams.