

We Can Still Do Hard Things

What Rare Earths, Tungsten, Semiconductors and Forty Years of Offshoring Should Have Taught Us

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PEOPLE | RESOURCES | SKILLS | MANUFACTURING | A STRONGER TOMORROW

RARE EARTHS
From the ground to a stronger future.

TUNGSTEN
A strategic material.
A familiar cycle.
A new opportunity.

SEMICONDUCTORS
Design it. Build it. Keep it here.

LESS DEPENDENCY. BRIGHTER HORIZONS.
Shorter supply chains mean greater security and a cleaner, more resilient future.

EDUCATION BUILDS TOMORROW'S WORKFORCE.
Not everyone needs a four-year degree. We need engineers, technicians, machinists, operators and innovators.

OUR MATERIALS. OUR PEOPLE. OUR CAPABILITY. A STRONGER TOMORROW.

SELF-RELIANCE CREATES CHOICES.

MINE
REFINE
MANUFACTURE
INNOVATE
BUILD
HERE

Innovation. Don't be in business without it.

For more than twenty years, I have said something that probably sounded ridiculous to some people: someday, we will make TVs in the United States again.

I never really meant just televisions. The television was simply a symbol. What I meant was that eventually America would rediscover the importance of making things.

For decades, we progressively allowed someone else to mine the material, refine it, manufacture the components and assemble the finished product because somebody, somewhere else, could do it for less money. On a spreadsheet that often-made perfect sense. Labor was cheaper, environmental compliance was cheaper, capital investment was somebody else's problem, and shipping across the ocean was inexpensive enough that the economics still worked.

So more of the difficult work migrated elsewhere. For a surprisingly long time, the system worked. Then we began discovering what we had sold had huge ramifications.

It wasn't simply labor. Along with it went capability, infrastructure, experience and thousands upon thousands of seemingly insignificant manufacturing decisions that collectively constitute industrial knowledge. Perhaps most importantly, we exported what might best be described as industrial memory.

Rare earths may be one of the clearest examples that are affecting us right now in a dramatic way.

The Mountain Pass rare-earth deposit in California was discovered in 1949. By the mid-1960s, Mountain Pass had become the dominant rare-earth source in the world. The United States did not merely mine rare-earth ore. It processed it, separated individual rare-earth elements and produced commercially useful materials. USGS describes the period beginning around 1965 as the "Mountain Pass era." From the mid-1960s through the mid-1980s, Mountain Pass dominated global production, and the United States was largely self-sufficient in rare earths. Large-scale solvent extraction enabled individual elements to be separated commercially, including elements that previously had been available only in small quantities. Much of the capability was created in very short periods of time at corporate levels.

That happened sixty years ago, before personal computers, before CNC machining became commonplace, before modern process controls, before CAD, and before much of the sophisticated analytical equipment and automation we take for granted today.

Yet we separated rare earths, refined them and converted them into useful materials.

The chemistry did not somehow become more complicated between 1966 and 2026. What changed was the industrial ecosystem surrounding this chemistry.

Samarium makes that contradiction particularly striking. Today, samarium is treated as one of the critical vulnerabilities in the Western permanent-magnet supply chain. That vulnerability is real, but the curious part is that America was processing rare-earth materials when our analytical and manufacturing technology was dramatically less sophisticated than it is today. Commercial quantities of a broad range of individual rare-earth metals became available beginning in the late 1950s, aided by Mountain Pass material and advances in government and private-sector metallurgy.

Yet today, establishing separation, metallization and magnet manufacturing can be discussed as though someone is proposing construction of a colony on Mars.

We did not forget the chemistry. The problem is that chemistry is only one component of an industry. You also need experienced engineers, operators, maintenance technicians, toolmakers, electricians, metallurgists, analytical laboratories, equipment manufacturers, suppliers, customers and managers willing to invest capital. And you need people who have operated the process long enough to recognize when something does not look, sound or behave quite right.

That knowledge does not arrive in a crate with the equipment. It accumulates.

Anyone who has spent a lifetime around manufacturing understands that a process contains knowledge that rarely appears completely on a drawing. The print may tell you what dimension to hold. The process specification may tell you what temperature to maintain. The machine manual may explain how the equipment operates. Yet there is often someone standing nearby who says, “Don’t run it exactly that way,” because they have seen what happens.

Maybe humidity matters. Maybe material from one supplier behaves slightly differently. Maybe a furnace responds differently after maintenance. Maybe a tool needs to be operated within a narrower window than its specification suggests. Maybe an apparently insignificant change upstream creates a problem three operations later.

None of those individual observations appears particularly profound. Collect thousands of them across thirty years, however, and you have something enormously valuable: industrial memory.

When an industry disappears, that memory begins disappearing with it. Equipment can be replaced, assuming someone still makes it or if that someone will even sell to you. Buildings can be reconstructed and chemistry relearned. Production process can be recreated as well. Replacing decades of accumulated experience? This is much more difficult.

That is one reason something America routinely accomplished fifty years ago can appear astonishingly difficult today.

By the late 1980s and early 1990s, China was rapidly expanding rare-earth production. USGS divides modern rare-earth production into distinct eras: the Mountain Pass era beginning in 1965, followed by a transition beginning in the mid-1980s and then a Chinese-dominated era beginning around 1991. By 1999 and 2000, more than 90 percent of the separated rare earths required by U.S. industry were coming either directly from China or through countries relying on Chinese feedstock.

That transition was not driven by a sudden geological discovery that America had no rare earths. Mountain Pass was still there and the technical knowledge existed. Economic competition, combined with increasingly difficult environmental and regulatory issues, changed the economics.

The warning signs were not hidden to us at all. USGS was writing about the consequences more than twenty years ago, noting that economic competition and environmental concerns were constraining Mountain Pass and that the United States had become more than 90 percent dependent on imported separated rare earths.

We watched it happen.

The pattern is not unique to rare earths. Tungsten offers a remarkably similar example. The Cantung mine in Canada's Northwest Territories operated from 1962 until 1986 and then closed because commodity prices had fallen too low to support continued operation. It later restarted, only to experience additional interruptions and re-openings as market conditions shifted.

The pattern has repeated often enough to be familiar. Western production operates until global prices decline and domestic or allied production becomes economically unattractive. Mines close and dependency increases. Then supply tightens, strategic concerns grow or prices rise, and suddenly Western production becomes attractive again. Capacity returns. Eventually prices weaken and the economy is challenged all over again.

A mine cannot operate indefinitely as a national strategic reserve while competing against material priced below the mine's economic operating cost. At some point somebody must answer a difficult question: what is security of supply worth?

The lowest price does not necessarily produce the most resilient supply chain.

It is tempting to describe companies that participated in offshoring as foolish, but that explanation is too simple. Imagine being a purchasing manager twenty-five years ago. Supplier A offers a component manufactured domestically for \$10. Supplier B offers the same component overseas for \$6. Quality is acceptable. Delivery is acceptable. Transportation costs are manageable. Your competitors are buying the \$6 component.

What are you supposed to do? Buy the \$10 component indefinitely because someday the foreign supply chain might become strategically problematic?

Your CFO probably is not going to celebrate that decision. The spreadsheet wasn't necessarily wrong. We simply weren't asking it to measure everything that mattered.

We measured cost per kilogram, cost per component, labor cost, inventory, transportation and return on invested capital. What rarely appeared on the spreadsheet was the value of domestic capability, retained knowledge, second-source availability, surge capacity, supply security, workforce development or simply knowing how to make something.

Those things looked worthless until circumstances revealed that they weren't.

This helps explain why rebuilding these industries now requires so much government involvement. Why can't a company simply decide that America needs samarium and build the capability?

Risk is a large part of the answer. Suppose someone invests hundreds of millions of dollars in building a Western refining operation. Production begins, global prices fall dramatically, and the new plant becomes less than economic. Investors lose money and the facility closes. We have already watched versions of this happen, which makes the next investor understandably cautious.

Long-term purchasing agreements can change that equation. They do not necessarily require government ownership or even direct grants. What industry often needs is a customer.

If the Department of Defense knows it will require strategic magnetic materials for decades, long-term commitments can fundamentally change the economics of constructing capacity. In July 2025, MP Materials and the Department of Defense announced a major long-term arrangement that included a 10-year NdPr price-floor commitment and a 10-year magnet offtake commitment tied to expansion of domestic magnet manufacturing.

The structure is important. Government does not always have to build the factory. Sometimes it needs to behave like a serious long-term customer.

Semiconductors tell much the same story on a larger scale. The United States invented much of the modern semiconductor industry and remains enormously important in semiconductor design and technology, but manufacturing moved. In 1990, the United States represented roughly 37 percent of global semiconductor manufacturing capacity. By 2022, that figure had fallen to approximately 10 percent.

Nobody forgot what a semiconductor was. What moved was the ecosystem around it.

Fabrication facilities relocated, and equipment suppliers, engineering expertise and experienced technicians clustered around the new centers of production. Other suppliers followed their customers. Students followed the opportunities, while capital increasingly flowed toward places where the infrastructure already existed.

Industrial ecosystems develop their own gravity. Once enough capability accumulates in one place, additional capability tends to follow. Reversing that process after decades of movement in the opposite direction is extraordinarily difficult.

There is another piece of this story that receives far less attention: education.

For several generations, America sent young people a very clear message: go to college. It was generally well-intentioned advice. Education expands opportunities, and universities are indispensable to research, engineering, medicine, science and innovation.

But somewhere along the way, we began confusing education with a four-year degree and created a subtle hierarchy around the work people did. The engineer designing the machine

was successful, while the machinist building it was somehow less successful. The chemist developing the process was celebrated, while the technician keeping it operating was merely labor. The person sitting behind a computer had a career; the person maintaining a million-dollar production system had a job.

That distinction was profoundly shortsighted.

According to the National Science Foundation, the United States had approximately 37 million STEM workers in 2024, representing about 26 percent of the workforce. Nearly half, 49 percent, did not have a bachelor's or advanced degree. More than 11 million workers without bachelor's degrees were employed specifically in STEM middle-skill occupations.

That is a useful reminder of what a technological economy looks like.

Innovation does not consist exclusively of engineers and Ph.D.'s. Someone must build the prototype, wire the controls, troubleshoot the servo, machine the tool, rebuild the pump, operate the furnace and understand why yesterday's production run behaved differently from today's. Eventually, someone also must teach the next person how to do it.

The educational system supporting an industrial economy therefore cannot end with "everybody should go to college." A better objective is that everybody should have the opportunity to become exceptionally good at something valuable.

For one person that may require a Ph.D. For another, a bachelor's or associate degree. Someone else may learn through an apprenticeship or by spending years beside a person who has spent thirty years mastering a trade. A technologically advanced economy needs all of them.

There is considerable attention given to America's need for scientists and engineers, and we absolutely need them. But rebuilding manufacturing also requires the entire ladder beneath them.

The Bureau of Labor Statistics projects nearly one million openings in production occupations every year from 2024 through 2034, primarily because workers will retire, transfer or otherwise leave their occupations. Industrial machinery mechanics alone are projected to add more than 41,000 manufacturing jobs during that period.

America is not simply facing a shortage of brilliant ideas. We also need people capable of turning ideas into physical reality. That means restoring prestige to technical education and creating many paths into useful, technically demanding work, from shop classes, robotics and machining to electronics, materials science, automation, toolmaking, apprenticeships, community-college programs, engineering and advanced scientific research.

Perhaps this is part of what was different during America's extraordinary industrial expansion of the 1940s, 1950s, 1960s and 1970s. There was tremendous cultural importance attached to creation. Airplanes were built, alloys developed, transistors invented, highways constructed,

machines improved and eventually human beings were sent to the Moon. Creating something that had not existed yesterday carried enormous cultural weight.

That does not mean everything about that period was better. It plainly was not. But there was unmistakable national confidence surrounding engineering, science, manufacturing and physical creation.

Somewhere along the way, we began assuming that someone else could handle an increasing amount of physical work. We would design and innovate while somebody else manufactured and produced. The problem is that those activities are not completely separable.

Manufacturing itself creates knowledge. Engineers learn from factories and factories learn from engineers. Customers challenge suppliers, suppliers invent processes, and technicians encounter problems designers never anticipated. Production problems become research questions, while research discoveries eventually find their way back into production. Separate those activities by thousands of miles for several decades and the feedback loop weakens.

This may be one of the most overlooked consequences of offshoring: along with factories, we exported repetitions.

Imagine two countries. One designs a product but manufactures relatively few of them. The other manufactures one hundred million. The second country encounters more production failures, solves more tooling problems, develops more process engineers, creates more specialized suppliers, trains more technicians and has vastly more opportunities to discover new manufacturing methods. It is accumulating more than products. It is accumulating millions upon millions of cycles of industrial learning.

That is industrial memory being created in real time.

None of this argues that America should manufacture everything it consumes. That would be neither realistic nor desirable. International trade creates enormous benefits. Our allies matter, specialization matters and global markets matter. But participating in global trade is very different from becoming incapable of functioning without one foreign supply chain.

Self-reliance, in this context, is about having options.

Can we obtain the material from multiple friendly sources? Can we refine some of it ourselves? Do we understand the process? Can production expand if circumstances require it? Is there a domestic workforce capable of operating the technology? Can industry survive disruptions?

Those are practical questions of resilience.

There is also a quieter environmental benefit to rebuilding regional manufacturing capacity. We transport an astonishing quantity of material around the planet. Ore may be mined in one country, concentrated in another, separated somewhere else, converted into metal somewhere else, made into a component elsewhere still, and then shipped to another country for assembly before finally reaching its customer.

Ocean freight is extraordinarily efficient per ton-mile, but it is not environmentally free. Ships consume fuel and ports consume energy. Intermediate products are packaged, handled, stored and transported repeatedly. Every additional movement introduces energy consumption as well as inventory and supply-chain risk.

The environmental argument for domestic and regional production does not need to become an ideological crusade. It can remain practical. If we can economically eliminate unnecessary journeys of thousands of miles, there is value in doing so.

The shortest supply chain will not always be the best supply chain. But neither should the longest automatically win because one intermediate processing step costs a few cents less overseas.

Permanent magnets illustrate nearly every part of this story. Consider everything hidden inside one apparently simple magnet: mining, mineral concentration, chemical separation, oxide production, metallization, alloying, powder processing, magnetic-material science, tooling, pressing or molding, heat treatment, machining, coating, magnetization, measurement, motor design and assembly.

Every stage contains specialized knowledge. Once those stages begin disappearing from a country, rebuilding the complete chain becomes much more complicated than simply purchasing a magnet press.

That is why today's effort to rebuild Western rare-earth and permanent-magnet production matters. America does not need to make every magnet it consumes. It should, however, retain the capability to make magnets, particularly when those magnets sit inside aircraft, automobiles, industrial automation, robotics, energy systems, medical equipment and national-defense systems.

So, when I said twenty years ago that we would someday make televisions in America again, perhaps what I was really predicting was the return of a realization.

At some point, the cheapest possible product stops being the only objective. Reliability, capability, knowledge, geography, people and resilience also have economic value. Occasionally the slightly more expensive component manufactured nearby turns out to have been extraordinarily inexpensive insurance.

The pendulum is beginning to move. Semiconductor fabrication is returning, battery manufacturing is expanding, rare-earth separation is being rebuilt, permanent-magnet manufacturing is being constructed and advanced manufacturing is receiving renewed attention.

Perhaps more importantly, we are beginning to rediscover that manufacturing is not some primitive activity from which an advanced economy eventually graduates.

Manufacturing is itself a technology.

That brings me back to samarium.

If Americans could separate rare-earth elements using industrial technology available in the 1960s and 1970s, there is no credible technological reason Americans cannot build sophisticated rare-earth processing infrastructure today.

It will require capital, environmental controls, permitting, engineers, technicians, long-term customers and people willing to accept risk. It will take time. None of that makes it impossible.

The harder question is whether we have the patience and conviction to rebuild what previous generations spent decades creating and then also maintain the commitment necessary to keep those industries alive once they return.

The greatest lesson from rare earths, tungsten, semiconductors and forty years of industrial migration is not that globalization failed. It is that capability has value even when it is not being fully utilized. Factories, mines, machine shops, universities, trade schools and the people inside them are pieces of the same industrial ecosystem. Together they represent the accumulated capacity of a society to convert ideas into physical reality.

Once that ecosystem is gone, recreating it is enormously expensive. Maintaining it would have been far cheaper. So, we have not forgotten how to do hard things. It seems like we have forgotten how valuable it is to retain the ability to do them.

Perhaps the most important thing we can teach the next generation is equally simple: do not be afraid of hard work. Learn chemistry. Learn about machinery and machining. Learn the software. Learn the trade. Design something. Build something. Improve something. Create something. Do not be afraid to do these things knowing that you WILL fail sometimes and that it is OK to do that too.

A nation that remembers how to create will always have choices.

A nation that forgets eventually becomes dependent upon those that did not.

#RareEarths #Tungsten #Semiconductors #Offshoring #USManufacturing #MadeinUSA

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