Abstract

This chapter uses Alcoa to tell the story of aluminum and anti-trust. Although aluminum is quite common now, it was a very difficult metal to refine before 1888. One American company, Alcoa, was responsible for the rise in the application of aluminum to various markets. In order to increase production and profits, Alcoa grew in both size and scope, as did many American businesses during the early twentieth century. Eventually, this company controlled 2/3 of the world's supply. But as Alcoa emerged as a big business, federal policymakers considered it a dangerous threat to competitiveness in aluminum production. Using the doctrine of anti-trust, the United States successfully knocked Alcoa down from its lofty place in worldwide markets in 1945. In doing so, those policymakers believed they had struck a blow for competitiveness, but the larger question arises: is a company that dominates the production of a single material bad in and of itself?

Aluminum, Alcoa, and Anti-Trust

1. Capping the Monument

Capping the Washington Monument in December, 1884 (Library of Congress)

Aluminum is the most common metal on Earth. It has amazing properties—it is resistant to corrosion, its low density means that it is one of the most lightweight metals, and it has a relatively low melting point, which means that it is easy to cast. We encounter aluminum nearly every day: it is in our beverage cans, our automobiles, planes, and on many our houses. In fact, you might say that aluminum is the most commonplace metal of all. But this was not always the case.

Take, for example, the story of the Washington Monument. Americans had been planning to build some sort of memorial structure to commemorate the life of their first president, George Washington, since the 1780s. But, as with many monuments, the construction was subject to great controversy. One of the designs, for example, fell by the wayside when it came out that the Pope had donated stone from an ancient Roman temple for its construction. When anti-Catholic nativists found out about this, they slowed construction on the project in the 1850s. Two decades later, construction resumed with a new design: a massive obelisk with simple, clean lines that formed a point at the top. Designers thought that a metallic pyramid on top could help with lightning and keep the edges sharp and clean. After considering bronze or copper, they decided instead to use a metal known for its attractive properties of conductivity and durability: aluminum. But they did not come to this decision because aluminum was cheap. In fact, this metal was quite expensive. In the 1880s, aluminum was about $16 a pound, or more than some American workers made in a week's work, and the 8-inch high cast aluminum pyramid cost a whopping $225—over $5,500 in today's prices. The idea of using aluminum signaled the high value, not the ubiquity, of this metal. When it was completed, the Washington Monument was the tallest man-made structure in the world, standing in at 555 feet, and it was topped with aluminum.[1]

2. Why is Alcoa Important?

At the dedication of the Washington Monument, aluminum was an exotic and expensive material. Casting the pyramid took several tries, and the manufacturer was worried that he might have use an aluminum-bronze alloy instead of pure aluminum. In fact, pure aluminum

was so rare it really was more of a luxury good than anything else. Some of the royal families of Europe, for example, used aluminum dinnerware as a sign of their elite status.

An Alcoal aluminum press in operation. Such facilities require massive capital investments, which makes competition in aluminum production an expensive strategy (Library of Congress)

The idea that an American company might unlock the secret of mass producing aluminum and find hundreds of applications for its use seems like a good one to us today—everyone likes technological innovation and efficiency. But what if this company grew so proficient at manufacturing and marketing aluminum that they controlled nearly 2/3 of the world's supply? Is it acceptable to have a single firm hold that kind of market share? Should government intervene to restore competition to that industry? Those were the questions faced by a company called the Aluminum Company of America in the years following World War I. This firm—later renamed Alcoa—was so good at making and selling aluminum they nearly cornered the market. But were they too successful for their own good? That's why the story of aluminum is wrapped up with the idea of "anti-trust," or the notion that a company that held a huge market share operated as a "monopoly." So why was Alcoa in such trouble?

This chapter will use the story of Alcoa up to 1945, when the federal government reduced the company's market share through an anti-trust case. This is an important example of how the political and economic context of a material can be critical in determining how it

was made, what markets it serves, and how it becomes an important part of everyday life. Aluminum was not common at all before the 20th century, but Alcoa set out to change all of that. Along the way, they became almost *too* good at making and marketing aluminum. How is that possible? And why should we be concerned if a manufacturer is dominating markets, so long as that material is cheap and abundant? To understand this question we need to understand the notion of ***anti-trust***, and how Alcoa played a pivotal role in this uniquely American phenomenon.

3. The Origins of Big Business

Alcoa had its origins in the late Nineteenth Century, at a time when big businesses began to dominate markets. Because of technological and organizational innovation, increasing efficiency in production, and ruinous competition, prices fell steadily from the end of the Civil War to the mid-1890s. So the only way firms could control prices in the 19th century industrial economy was to control market share. Basically, companies became bigger and bigger in order to become price-makers and not price-takers; in other words they didn't want to leave their business to the whims of the marketplace. Instead, they sought to control their own economic strategies by growing in size and in scope, dominating the market for their goods, and setting their own prices.

These large industrial firms tried to centralize production and cut costs. There were two main goals. First, large firms built larger and larger factories in order to capture what historians call ***economies of scale***. Basically, before the Civil War, most industries were subject to what economists referred to as "constant returns to scale," this means that although a bigger factory

might allow the production of more goods, the costs per unit were roughly the same—for example, if you put 100 looms in a factory, it wouldn't necessarily be cheaper cloth per unit than a single loom. After the Civil War, technological and organization changes brought "economies of scale," which means that a large, expensive plant could produce goods more cheaply on a per-unit basis than small producers. Take, for example, flour mills and oil refineries—usually massive capital outlays are required to build such plants. Second, managers focused on reducing "***throughput"*** within those factories. Throughput is basically a measure of the speed and volume of the flow of materials through a single plant or works. A high rate of throughput—which managers usually measured in terms of units processed per day—became the critical criterion of mass production. If a company did well on these measures, it likely was a large corporation with a huge physical infrastructure—a great departure from the small-scale businesses of earlier in the 19th century.

This 1902 cartoon uses baseball as a metaphor for how the "trusts" were perceived as dominating businesses and hurting Americans. (Library of Congress)

<u>4. Checking the Trusts</u>

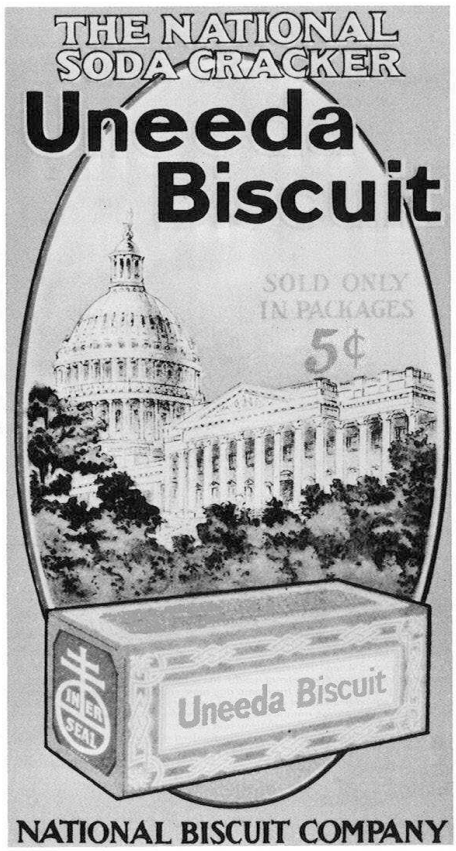
Economists call a system in which a few large corporations dominate the marketplace "oligarchic." Historians say that the Era of Big Business saw the rise of the "trusts," which refers to Standard Oil's legal maneuver to control over 90% of the oil refining business in the U.S. economy via a system in which companies surrendered stock certificates—and control of their company—to John D. Rockefeller via his Standard Oil Trust. Many Americans thought that the government should do something about the unchecked power of these trusts in industries like oil, sugar, beef, steel, and even whiskey. After all, if a company had a commanding market share, who is to say that they won't jack prices up to monopolistic levels? This kind of control seemed undemocratic and, to many voters, un-American. So in 1890, Congress passed the Sherman Anti-Trust Act, which makes "restraints of trade" illegal and aspired to break up trusts that undermined the public interest. But the statute was vague in defining these principles. What is a "restraint of trade," and how do you find it? The law didn't provide any guidelines or examples, so enforcement of the law, by default, falls in the hands of the federal government to determine what a monopoly is and what isn't.

So how do you enforce a law that is so vague? Actually, the Department of Justice first used the Sherman Act against unions. Of the first ten cases tried under the legislation, five were against unions that supposedly acted in "constraint of trade." In 1895, the Supreme Court seemed to get the ideal opportunity to break up a trust. The American Sugar Refining Company acted in sugar in much the same way that Standard Oil did for oil—but worse—they control about 98% of market share by the 1890s. But even though the sugar trust dominated the American market, the Supreme Court, in the U.S. vs. E.C. Knight (1895) made a very strict—and to be honest, very dubious—distinction between the Sherman Anti-Trust Act's applicability to

commerce and its applicability to manufacturing. The Court argued that anti-trust laws really only applied to commerce, not manufacturing, and unless the American Sugar Refining Company built a factory that literally straddled a state boundary, the issue was for state courts, not the Supreme Court, to decide. Since the four major sugar refineries owned by the American Sugar Refining Company were in Pennsylvania, it was a matter for the Pennsylvania courts to decide.[2]

5. Big Business Gets Even Bigger

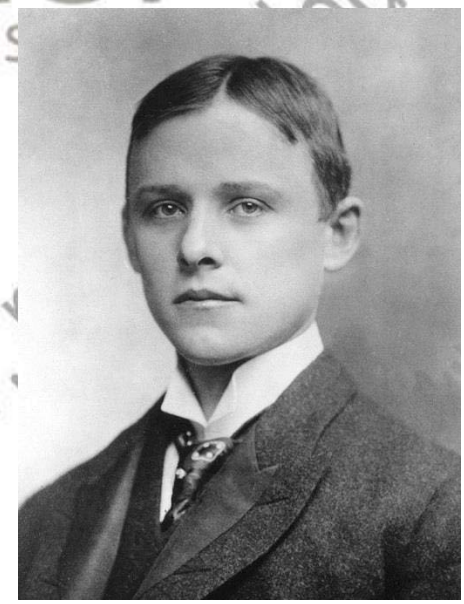
The way that American courts enforced anti-trust meant that firms couldn't form any kind of informal organization, like a cartel or trust. So **horizontal integration** offered the best strategy—you simply acquire your competitors and increase your market share. That way you create major barriers to your potential competitors because they'll have to catch up in the race to achieve economies of scale. To pursue this strategy, many firms used mergers or the outright hostile acquisition of other firms. The first major merger wave in American history occurred during the years 1895 through 1904. Over this stretch of nine years, more than 2,000 previously independent firms disappeared. In 1899, there were about 1,200 recorded mergers—pretty huge considering that there were less than one hundred mergers in 1896, less than four hundred in 1900, and then back to less than one hundred in 1904. The firms that emerged from this merger movement often dominated markets and continued to expand in size through both horizontal and vertical integration. Here's an example: in 1898, three regional companies, New York Biscuit, American Biscuit and Manufacturing, and the United States Baking Company, joined to form the National Biscuit Company. The directors of the new firm decided to embark upon a two-pronged strategy—centralize production through buying out competition and integrate forward to the customer. So after 1900, National Biscuit attempts to



capture economies of scale through the consolidation of production facilities and increases in throughput. They also try to develop specific brand names, like "Uneeda Biscuit" and blitzed consumers with increased advertising. With this strategy, National Biscuit kept unit costs low and created major barriers to entry for new competitors—who were limited to a few firms structured like National Biscuit, but usually operating on a regional scale. Many industries had their version of National Biscuit by the early twentieth century: U.S. Steel dominated steel, American Tobacco dominated the tobacco industry, American Bell in the telephone industry, the International Paper Company in paper.

6. Aluminum Becomes Cheap

So what does this all have to do with Alcoa? Well, at about the same time that the Sherman Act appears and American businesses start to grow so rapidly, there were changes in the aluminum business. Charles Martin Hall, in Oberlin, Ohio, was experimenting in the woodshed of his kitchen and developed an inexpensive way to smelt aluminum. In 1888 he filed a patent for his discovery and organized the Pittsburgh Reduction Company, which in 1907 was renamed the Aluminum Company of America, later shortened to just Alcoa. Hall was initially excited about his breakthrough, until he learned that Paul Héroult of France had discovered the same thing at



Charles Martin Hall in the 1880s (Wikipedia)

As big businesses attempted to capture market share, they often mass-produced products meant to insure consumer loyalty. (Library of Congress)

virtually the same point in history. Héroult got a French patent, but never really spun his aluminum process into a commercially viable endeavor.

The Hall-Héroult Process, as it is called, smelts aluminum metal by passing an electric current through a solution of aluminum oxide that is cased in a substance called cryolite, which is sodium aluminum fluoride. After running the current through this solution, pure aluminum begins to form on the end of a graphite rod. Initially, this process made very small amounts of aluminum, but once larger pots and a steady source of electricity could be applied, this once very difficult task of smelting aluminum became commercially viable.[3]

7. Selling Aluminum

When the Washington Monument was capped with an aluminum pyramid in 1884, it was about $16 a pound—that's nearly $400 in today's prices—but Hall's process initially reduced that cost in half and by 1900 his company could make aluminum for about 33 cents per pound. Aluminum very quickly evolved from an exotic metal to a lightweight material that had many potential functions. At first Alcoa sold mostly ingot and sheet aluminum and soon moved "downstream" towards the

Why Hall-Héroult?

There are many good descriptions of the Hall-Héroult Process available online. But why does it have this split name?

As it turns out Charles Martin Hall and Paul Héroult discovered a similar process for smelting aluminum at nearly the same time. Héroult actually had received a French patent and was working on an American one when Hall filed his petition in 1886. After months of litigation, courts determined that Hall had been working on the process in the United States before Héroult filed for an American patent, and so Hall could continue to make aluminum.

These two founders of aluminum met only once, in 1911. Even though their careers took very different paths-- Héroult became more interested in steel than aluminum after the patent struggle—their lives seemed destined to be intertwined. Charles Martin Hall and Paul Héroult both died in the exact same year of 1914.

Here is a video that shows how modern aluminum is produced by the Hall-Héroult Process.

consumer and make new goods. Teakettles and utensils, for example, became part of their lineup when they acquired utensil manufacturers. Aluminum's non-corrosive properties allowed the company to sell sheeting and tubing as well. And by 1908 they were fabricating wire, and moved into the utilities market. As the automobile market developed, aluminum was a natural fit because of its lightweight alloys.

Alcoa grew very rapidly: from 1900 to 1914, the company's capital surged from $2.3 million to more than $90 million. During that time, the firm's leaders, Arthur Vining Davis and Alfred Hunt, embarked up on a policy of rapid growth in order to achieve economies of scale. They built a massive facility to generate electricity at Niagara Falls and moved beyond Pittsburgh to build large smelting facilities in New York State, Tennessee, and Canada. In order to improve throughput Alcoa acquired bauxite mines in Arkansas and built a refining plant in East St. Louis in order to create alumina, the material that the Hall-Héroult Process used in order to refine aluminum metal. World War I was particularly good for business, as Alcoa increased production from 109 million to 152 million pounds; and wartime applications took up to 90% of the firms' production. But government officials were wary, and in 1917 the War Industries Board accused the company of unfair practices when they charged a bit more for aluminum canteens than the market price. Scrutiny of Alcoa—and talk of anti-trust proceedings—began to increase.[4]

8. The Anti-Trust Problem Starts

Part of the problem was that Alcoa was coming of age during the time that the Federal Trade Commission (FTC) and the Clayton Act appeared in 1914. The FTC was created as an

independent commission to enforce antitrust laws. It had five members that were elected to seven year terms, in order to isolate the members of the FTC from political influences. It supposedly had broadly granted investigatory powers and could theoretically order businesses to stop a particular action, if it thought the firm was acting in violation of anti-trust laws. The Clayton Act shored up antitrust laws by making certain practices illegal. It did not allow contracts between firms that restricted firms from doing business with competitors, and it did not allow price discrimination in the effort to limit competition. For labor unions, the Clayton Act was important because it ruled that unions were not illegal combinations in the constraint of trade—remember that this is what the Sherman Anti-Trust Act was originally used to enforce. All this shoring up of anti-trust agencies meant that Alcoa's executives had a great deal to worry about as they grew their market share during World War I.

The Southern Aluminum Company, centered in Badin, North Carolina and backed by French investment capital, attempted to compete with Alcoa in markets across the American South. This gambit failed—Alcoa was too strong by this point—and the company's Board of Directors voted to sell all of their assets. In the era of American Big Business, this should have been a classic case of merger and acquisition, but Alcoa walked cautiously in this case. And although it bought the assets Southern Aluminum Company in 1915, Alcoa asked for clearance from the FTC. This process was called "advance advice," and it was one potential way for U.S. policymakers to regulate the growth of industrial firms.[5]

Nevertheless, Alcoa had become an effective monopoly. Arthur Varning Davis admitted as much when he testified before the War Industries Board in 1918. "I suppose it has always

been our aim to foster this industry," he told government officials. Alcoa considered itself to be the "father as well as the creator of this industry," and in regards to competition, "it has always been our conception that the stability of price was the basis on which to build the industry."[6]

9. Finding Markets for Aluminum

In the 1920s and 1930s, Alcoa began aggressively expanding its product line and aluminum became a commonplace metal in American industries and in the home. There were lightweight window frames, decorative railings, and all sorts of goods that took advantage of aluminum's special properties. In products that needed to be light, for example, aluminum could replace iron or copper. The virtues of aluminum's resistance to corrosion also became a selling point for many products. In 1928 an Alcoa ad bragged that "the transforming power of aluminum paint" could transform dingy industrial villages into modern towns.[7]

The decorative doors leading into the Aluminum Research Laboratory in New Kensington, PA. They are made out of, you guessed it, aluminum. (Wikipedia)

In 1930 Alcoa built the Aluminum Research Laboratory, in which the company enlisted full time research scientists at New Kensington, Pennsylvania to develop new alloys, products, and improve the smelting and refining process. The scientists there worked on plastics, stainless steel, nickel alloys, and magnesium—they not only worked on aluminum products for contemporary times, scientists there also tried to anticipate alternative technologies that might replace aluminum. Basically Alcoa paid very smart engineers and scientists to think of ways to reduce the cost and promote

the use of aluminum. It was about as close to "pure" research as one could find in the private sector, and Alcoa's commanding market share shielded the Aluminum Research Laboratory's staff from the pressure to develop new products immediately.

10. The Federal Government Acts

But even though it fostered a corporate culture of size and stability, Alcoa's dominance over aluminum markets created problems for the firm. In 1938, Alcoa celebrated its 50th anniversary while preparing a defense against an anti-trust lawsuit. The Justice Department wanted to "create substantial competition in the industry by rearranging the plants and properties of the Aluminum Company and its subsidiaries under separate and independent corporations." During the New Deal Era of the 1930s, American policymakers became more

During World War II, Alcoa helped build the American bomber fleet. Not all of them were named after aluminum like this one, but all of them utilized aluminum parts. (Florida State Archives)

and more concerned that large industrial corporations were dominating the economic landscape. Even though Alcoa was not rapacious in dealing with its competitors, the U.S. Department of Justice argued that its size and market share alone made it an appropriate target for anti-trust proceedings. The case lasted 176 days and Alcoa spent $2 million defending itself and, although the case was undecided when Japan bombed Pearl Harbor in late 1941, it continued during the war. One of Alcoa's executives complained, "If we are a monopoly, it is not of our choosing." Despite the lawsuit, Alcoa became heavily involved in the war effort, producing 3.5 billion pounds of aluminum that went toward the manufacture of 304,000 airplanes. Many of these airplanes used alloys that Alcoa had developed in their laboratories.[8]

But, the government still pursued the case and in 1945, on appeal, a Circuit Court justice with the greatest legal name of all time, Learned Hand, gave the verdict. He argued that there was no such thing as a "good monopoly" and that there was no way that any company could achieve a monopoly share simply through efficiency and good business practice. So, in the postwar years, Alcoa saw many of its facilities sold

Alcoa and Uncle Sam

When the United States entered World War II in late 1941, most aluminum production was meant for civilian applications. By 1945, the company had built eight new smelters, eleven new fabricating plants, and four new refineries. Alcoa accounted for70 % of the capital investment in aluminum and more than tripled its work force to reach 95,000 employees. Despite their successful contribution to the war effort, federal authorities renewed their anti-trust suit against Alcoa.

Here is a video that shows the production of aluminum during World War II

for pennies on the dollars to its competitors, Reynolds Aluminum and Kaiser Aluminum. In 1950 the Court set Alcoa's market share at 50.85%, which, at least in their eyes, put them in a more competitive relationship with Reynolds (30.94%) and Kaiser (18.20%).[9]

11. A Post-Alcoa World

This application of the Sherman Anti-Trust Act really had a major impact on American business. If Alcoa could be broken up because of its market share alone, then other firms might be wary of achieving economies of scale and improving throughput in order to repeat Alcoa's success. So, in the postwar era, many large industrial firms chose to grow in a completely different fashion. Whereas Alcoa sought to gain control over the production of a single material, many postwar firms sought to grow in completely different ways.[10]

Take, for example, the story of Textron, which began as a textile business. Its owner, Royal Little was good at making textiles, but after WWII, the textile industry was a volatile one that suffered immensely from market swings. Little knew that he wasn't going to dominate the textile industry; even if he did, in the post-Alcoa anti-trust environment, the Supreme Court would probably come after him. So, beginning in 1954, Little devised a new strategy for Textron. He began acquiring small and intermediate sized firms at a rate of about two per month, and was borrowing heavily to do it. In 1956 alone, Textron purchased firms that made cement, aluminum, bagging, plywood, leather, and Hawiian cruise ships. Little also began to sell off Textron's unprofitable divisions—much of which was textiles—and by 1963 he had sold the last of Textron's texile plants. By 1968, Little was in semi-retirement and Textron had

revenues of $1.7 billion and earnings of $76 million. It was #49 on *Fortune Magazine*'s list of the 500 largest companies —even ahead of Alcoa, which had dropped to #56!

The other example of the move away from Alcoa's growth strategy is the story of International Telephone and Telegraph, or ITT. This firm was founded as a small telephone company in Puerto Rico and Cuba in the 1920s, and it was moderately successful when Harold Geneen took it over in 1959. After that point, ITT began to expand rapidly. It acquired Avis in 1965, Cleveland Motels in 1967, Pennsylvania Glass and Sand, Continental Baking, Sheraton Hotels, all in 1968. You can see where this is headed. But ITT was even more expansionist than Textron: By 1970, ITT has 331 subsidiaries and 708 subdivisions. It operated in 70 countries, had 400,000 employees, and sales of $5.5 billion--#21 on that same 1968 Fortune 500 list!

Both ITT and Textron proved to the business world that you could get big fast—and you didn't even have to be particularly innovative in what you produced. With some creative accounting, gutsy acquisitions, and stock swaps, Textron and ITT became giants over the course of a decade. And they did it with a completely different strategy than Alcoa. Rather than make one thing exceptionally well, conglomerates sought to make profits across many markets, and avoid any anti-trust problems altogether.

13. The Beer Can Barons

The Aluminum Can

Chances are you've drank from an aluminum can at some point over the last few days—perhaps a diet soda or even a malted beverage—without thinking about the materials and design that went into that can.

In 1959, Coors Brewing introduced the first all-aluminum beer can, and five years later, RC Cola trotted out its own version of a soda can. Although the aluminum can went through some design changes, like adding a removable pop top, then replacing that with a tab that stayed riveted to the can, its basic shape remained the same. By the 1980s, aluminum cans made up more than 95% of the soda and beer can market. A true success story that is attributable to aluminum's lightweight durability.

Here is a video that demonstrates the innovative nature of aluminum cans.

Don't weep too much for Alcoa in the postwar era. From 1946 to 1958 its gross revenues tripled up to $869 million. One writer in 1955 called it Alcoa's "splendid retreat" from monopoly. By 1952, moreover, aluminum had passed copper in civilian consumption and now is second only to iron. In 1977, the NASA's Space Shuttle Enterprise, covered by an aluminum alloy, made its maiden voyage on top of a specially modified Boeing 747 jetliner, also covered

with an aluminum alloy. But in addition to conquering sky and space, aluminum became integrated into daily life through more humble means. In new markets, like beer and soft drink containers, aluminum went from less than 2% in 1964 to 95% of the market in 1986.

14. Legacy

An example of aluminum's value to the modern world: the Space Shuttle Enterprise hitches a ride on a 747. Both are covered in aluminum alloys. (NASA.gov)

But the question remains, is a commanding market share indication of a troubled industry, or can a company be *too good* at its business? That's why Alcoa's story is important to consider. The bottom line is that Alcoa did popularize the use of aluminum among American consumers, made their products cheaper, and contributed to the growth of the industrial economy of the Twentieth Century—particularly in vital sectors like the airline industry. But as the name of Alcoa became synonymous with the production of aluminum, it also became

notorious among anti-trust circles. In the end, the federal government decided that such a large company was naturally incompatible with their view of modern industrial capitalism. The breakup of Alcoa hardly destroyed the company, but it did send a larger message out to firms like Alcoa that might have forged ahead with the large-scale production of their materials. In the postwar American economy, companies still grew large, but often did so with a completely different strategy then Alcoa had employed in its first half-century of growth. So not only did the emergence of Alcoa help structure the American economy of the early Twentieth Century—quite literally in the case of aluminum construction products—but its breakup helped structure the ways in which businesses grew in the late Twentieth Century.

Further Reading

Charles Carr. *ALCOA: An American Enterprise*. New York: Rinehart & Company, 1952.

Chandler, Alfred. *Scale and Scope: The Dynamics of Industrial Capitalism*. Cambridge, MA: Harvard University Press, 2009

Peck, Merton J., editor. *The World Aluminum Industry in a Changing Energy Era*. Washington, D.C.: Resources for the Future, 1988.

Smith, George David. *From Monopoly to Competition: The Transformations of Alcoa, 1888-1906*. New York: Cambridge, 1988

Stuckey, John. *Vertical Integration and Joint Ventures in the Aluminum Industry*. Cambridge, MA: Harvard University Press, 1983.

Discussion Questions

1. Can you think of any other materials that are currently considered luxury products, but might revolutionize everyday life if they became more widely available?

2. Do you agree with Alcoa's early strategy of engaging both in the mass production of aluminum **and** developing new markets for aluminum products? Were company officials seeding their own destruction by trying to do everything with aluminum?

3. Do you think that anti-trust actions against Alcoa helped or hindered the American economy in the long run?

4. Do you think that there is a need for anti-trust legislation today? Does the federal government need to break up large companies in the interest of competitiveness?

---

[1]George J. Binczewski, "The Point of a Monument: A History of the Aluminum Cap of the Washington Monument *JOM* 7 (1995): 20-25. Accessible online at http://www.tms.org/pubs/journals/jom/9511/binczewski-9511.html.
[2]Naomi Lameroux, *The Great Merger Movement in American Business, 1895-1904* (New York: Cambridge University Press, 1988), 164-166.
[3]American Chemical Society National Historic Chemical Landmarks. Hall Process: Production and Commercialization of Aluminum.
http://www.acs.org/content/acs/en/education/whatischemistry/landmarks/aluminumprocess.html
[4]Alfred Chandler, *Scale and Scope: The Dynamics of Industrial Capitalism* (Cambridge, MA: Harvard University Press, 2009), 122-124
[5]Mira Wilkins, The History of Foreign Investment in the United States, 1914-1945 (Cambridge, MA: Harvard University Press, 2009), 32-33
[6]George David Smith, *From Monopoly to Competition: The Transformations of Alcoa, 1888-1986* (New York: Cambridge University Press, 1988), 112-113.
[7]Marchand, *Advertising the American Dream: Making Way for Modernity, 1920-1940* (Berkeley: University of California Press, 1985), 262.
[8]Smith, *From Monopoly to Competition*, 191-202.
[9]Smith, *From Monopoly to Competition*, 242.
[10]A. Tony Freyer, *Antitrust and Global Capitalism, 1930–2004* (New York: Cambridge University Press, 2006), 32-40.