Chapter 3

The young entrepreneurs

Soon after producing globules of aluminum metal in his woodshed laboratory, Charles Martin Hall went out in the real world in pursuit of financing to put his new process to work. After filing his patent application on July 9, 1886, Hall tried to find financial backing in Boston and Cleveland. [1] Eventually he turned to the Cowles brothers, who met Hall for the first time in July 1887 and offered him a chance to work at the Cowles Electric Smelting Co.'s plant in Lockport, N.Y. The company provided Hall with the equipment and services necessary to develop his new process for reducing aluminum and paid him a salary of $75 per month. [2] At the end of 90 days, Hall was to receive $750 if the company decided to continue its investigation of his process, and the company had the option of purchasing Hall's patent within six months by giving Hall a one-eighth interest in the company, equal to 2,500 shares when the company was recapitalized. [3]

In a letter used as evidence in a later patent case, Edwin Cowles explained the company's contract offer. "We reasoned as follows: If some parties were to get hold of his process, there might be great danger of its killing our process," he said. "As a matter of prudence, we concluded to make some experiments with it. We laid the matter before the Board and they were unanimously of the opinion that it was best that we should make the contract. To be sure, it will cost us a few hundred dollars, but it is a good investment for us on the same principle that we should pay out the same amount to guard against losses by fire. The fact that the young man produced several buttons of aluminum on a kitchen stove alone is sufficient evidence that he might become a great inventor. The price we pay for it will be low if we can produce the pure metal at less than a dollar a pound, for we could, in that case, sell our foreign patents for half again as much, if not double or treble." [4] The Cowles, however, chose not to use the Hall patent, Hall recalled in his memoirs, but the reason was unclear. Some employees in Lockport later recalled it was a disagreement about "external heat and copper electrodes" versus "internally heated furnace and carbon electrodes." Alcoa company officials later said the disagreement was an attempt by the Cowles brothers to "suppress (Hall's) new process by buying him out." Hall left after one year with the Cowles in July 1888. [5]

Patent origins and claims

In his 1958 book "The True Story of Aluminum," a family descendant named Alfred Cowles said the Cowles brothers were familiar with what Hall had to offer. One month before they met Hall, they had received from their agent in London drawings and

specifications for the Heroult patent that explained how alumina, dissolved in molten cryolite, could be electrolyzed into aluminum. Five months prior to that, they had purchased patent rights to a similar electrolytic method developed by Joseph Buguski of Poland. In addition, according to this account, the Cowles Electric Smelting Co. had been experimenting with similar processes for reducing alumina before they ever met Hall. Testifying in a 19th century patent case, Edwin Cowles' brother Alfred said he knew about the use of cryolite for reducing alumina as early as 1884 or 1885. As evidence, they cited Lockport plant manager Romaine Cole's July 9, 1887, order for 200 pounds of cryolite and 200 pounds of alumina from the Pennsylvania Salt Co. to continue these experiments. [6]

Once Hall was employed by the Cowles, the company's experiments went in a new direction. Hall moved away from carbon anodes in favor of copper. He also moved away from cryolite, the double fluoride of aluminum and sodium, to a double fluoride bath made up of aluminum and potassium. And he turned to using external heat rather than the internal heating by electricity, which had been developed over the years by the Cowles. All of these changes failed. The copper anodes were not consumed by the reduction reaction, as Hall had hoped, and over time they melted into the bath. Whereas the bath containing potassium had a lower melting temperature, it attacked the crucibles and anodes, and the use of external heating forced Hall to use smaller crucibles with a thinner carbon lining that would never produce practical amounts of aluminum and wore down quickly. [7]

On Jan. 25, 1888, Hall submitted a report on his experimental work to the Cowles Electric Smelting and Aluminum Co.'s board of directors. Hall discussed his success in developing his process for commercial purposes. "I have now gained a thorough knowledge of the requirements of my process," he wrote. "It is now certain that very pure materials will not be required. The lack of success for a long time was due to improper mechanical arrangements and lack of adjustment of the current… Recently over a pound of pure aluminum has been made. In order to make it pure and to make it more economically, all that is required is less crude apparatus. The prospect now is that the process is all that was supposed at the start. The results of the past six month's work will appear in the future development of the process." [8]

But Hall's patent modifications from July 9, 1886 through April 1889 showed how his ideas were changing back and forth. Among the patent amendments he filed was one on Sept. 4, 1888, when he abandoned the copper anodes in favor of carbon. Four months after Hall arrived at Lockport, Dudley Baldwin, the Cowles's general manager, wrote to Edwin Cowles saying that "Hall is doing no good. I'm very tired of him. He made one good run of which I wrote you, but he can't duplicate it to save his life. He

keeps no notes and says he has now forgotten or lost track of the process leading to the good result." In later years, Romaine Cole, who had been a salesman for Cowles, testified that Hall never made a sufficient quantity of aluminum while he was at Lockport to prove what his process could do. [9] By another account, Hall's second patent application in January 1887 proved worthless – the process produced only 12 ounces of 93% pure aluminum at a time after 125 production runs. The Cowles brothers lost interest in Hall's invention, despite the fact that he could produce pure aluminum for less electrical energy than the Cowles could produce alloys. [10]

The Pittsburgh start-up

Through his contact with Romaine Cole, Hall met the noted metallurgist Capt. Alfred Ephrain Hunt in Pittsburgh, Pa., in July 1888. Hall and Cole produced a 22-page document describing the advantages of the "Hall Process," which persuaded Hunt to become one of the principal investors in Hall's new process. [11] One of the founders of the Pittsburgh Testing Laboratory, Hunt had worked with Cole several years earlier with experimental but unsuccessful attempts to convert alumina into aluminum through the use of an open-hearth furnace. Hunt had graduated from the Massachusetts Institute of Technology in 1876 with a degree in metallurgy and mining. He had worked at the Bay State Iron Works in Boston, which operated the first open-hearth steel furnace in the U.S., and he was later in charge of the open-hearth department at Nashua Iron & Steel Co. in Nashua, N.Y. Hunt came to Pittsburgh in 1880 to take charge of the open-hearth department at the Black Diamond Steel Works, where he worked with a young chemist named George Clapp. By 1887, Hunt and Clapp had acquired the Pittsburgh Testing Laboratory, which tested materials and conducted engineering inspections. Hunt served as a salesman and engineer for the company. He had served in the Spanish-American War in 1884 as the officer in charge of a National Guard battery that fought in the Puerto Rico Campaign. [12] A renowned industrialist who influenced an effort to purify Pittsburgh's public water supply, Hunt also served on a city commission tasked with finding a remedy for the smoke nuisance in the city. [13]

Based on his own experience trying to produce aluminum metal, Hunt was immediately interested in Hall's new process. He quickly gathered together a group of five friends and associates in his living room on July 31, 1888 and told them of a unique opportunity. Hunt included Clapp in the proposed venture, even though Clapp was away at the time traveling in Europe. The group of young men – the eldest was 35 and Hunt was 33 – agreed to join together in the business of producing aluminum using the Hall process. [14] The original investors included Hunt, Clapp, Millard Hunsicker, Horace W. Lash, W.S. Sample and Robert J. Scott. [15] The six men agreed on Aug. 8, 1888, to put up $20,000, at the rate of $5,000 at a time, to construct a pilot plant. The group chose the name

Pittsburgh Aluminum Co. and then incorporated under the name Pittsburgh Reduction Co. on Oct. 1, 1888. [16] They also agreed that if the endeavor proved successful, a sizeable corporation would be formed in which Hall and Cole would receive nearly half of the capital stock. [17] Hall assigned his patent to the new company and went to work. [18]

Cole, who had been one of Hunt's laboratory assistants, was assigned to work with Hall. Cole had good business sense, and he later helped Hall negotiate a contract with the investors that gave Cole and Hall 47% of the company's common stock. But Hall and Cole were unable to work together. Eventually Cole left and Hall became the plant superintendent. Cole's replacement was Arthur Vining Davis, a 22-year-old graduate of Amherst College sent by his father to work with Hunt, a friend of the family. [19] Davis was the new company's first employee. Hunt had initially hired Davis to work at the Pittsburgh Testing Laboratory but soon decided Davis would work well with Hall. In the beginning, Hall and Davis worked 12-hour shifts and soon were producing 30 to 50 pounds of aluminum per day worth $8 per pound. [20] Davis and Hall divided the job of managing five men 24 hours per day and made an outstanding team – with Hall a researcher and Davis an earnest and driving superintendent. [21]

On the night before Thanksgiving Day in November 1888, the Pittsburgh Reduction Co.'s first aluminum production plant began operating in a couple of rooms in a building on the 3200 block of Smallman Street in Pittsburgh. The equipment operated nonstop for about a year until replaced by larger equipment. One 125 horsepower steam engine drove two dynamos capable of generating 1,000 amperes each at 25 volts. One horsepower equals 746 watts, so each steam engine was rated at 93,250 watts, or 93.25 kilowatts. The first electrolytic cells, or pots as they came to be known, were made of cast iron and measured 25 inches long, 16 inches wide and 20 inches deep. The pots had a 3-inch thick carbon lining to create an electrical connection to the pot as the cathode. The anode consisted of six to 10 carbon rods measuring 3 inches in diameter and 15 inches long suspended by 3/8-inch copper rods from an overhead common copper buss. [22] During a blizzard on Thanksgiving Day, the Pittsburgh Reduction Co. poured its first aluminum ingot. [23]

Each pot held about 200 to 300 pounds of cryolite bath and was capable of producing 50 pounds of aluminum per day. Two pots were arranged in a series electrical connection and used 1,700 to 1,800 amperes at 16 volts, which was the normal operating voltage. In a series connection, the current remains the same as it passes through each successive reduction cell but the voltage will drop depending on the resistance inside each of the cells. Each pot was set on a brick hearth so it could be heated from below by a natural gas flame if necessary. After a few weeks of operation, the company found that the heating effect from the electrical current was sufficient to keep the contents of

the reduction pots in a fused state, and the gas flames were turned off. Alumina for the pots was purchased as aluminum hydrate from Silesia and calcined at the Smallman Street works to form anhydrous alumina. Raw materials are calcined when they are reduced, oxidized or desiccated by roasting or strong heat. In modern aluminum smelters, alumina arrives as a very fine dry white powder that resembles talcum powder. The Smallman Street plant also was equipped with a furnace for baking the carbon linings of the reduction pots before putting them to use. [24]

Perfecting the pots

When the pilot plant began operating, the reduction pots produced about 50 pounds of aluminum per day at a cost of about $5 per pound, far below any competing prices, but with little demand for aluminum the company dropped the selling price to $4 and then to $2 per pound in half-ton lots to stimulate demand. Hall wrote about the lack of demand in a letter. “The mention of $2 in 1,000-pound lots didn’t seem to interest anyone,” he said. “I know a good many people look at it as a big buy, and they have reason to do so, as they know that the total consumption of aluminum in the U.S. has hardly been 1,000 pounds a year. People have said we didn’t have 1,000 pounds. They were wrong, but they might have said that, so far as the users of aluminum were concerned, practically no one wanted 1,000 pounds.” [25]

Developing the production process for commercial purposes was difficult. By early 1889, Hall and Davis were working 12-hour shifts around the clock seven days a week to prevent the crucibles from freezing up. Eventually a night superintendent was hired and then two “furnace men” to tend the pots. Hall and Davis, however, could not meet the company’s projected production of 250 pounds per day. With all their effort in a hostile working environment, the two were able to produce only 30 to 50 pounds per day that sold for $8 per pound. Supplying electrical power to the pots was a major difficulty, and oxygen liberated from the alumina combined with the carbon anodes, constantly burning them away and producing carbon monoxide. The cryolite bath broke down unless just the right amount of alumina was dissolved into it. And the whole process had to be constantly watched to maintain the correct voltage. [26]

When larger pots were introduced, Hall and Davis discovered that less electrical power was required per unit volume of bath and the heating effect of the electrical current could maintain the pots’ temperature without an external gas burner. But the constant attention needed by the electrolytic reduction process created labor problems. The first potmen were neither diligent nor skilled. Hall and Davis needed workers who would show up at work on time, follow a tight schedule, do simple arithmetic, follow directions for mixing raw materials, keep a close eye on the hot pots and understand the ethereal

properties of electricity. Eventually Davis recognized that "labor enters relatively into the cost of aluminum much more than into the cost of any other metal whatsoever." He also recognized that aluminum workers would command a premium wage. [27]

Six months after starting the pilot plant at Smallman Street, the company was able to sell 50 pounds of aluminum per day at $5 per pound. By the fall of 1889, in spite of slow business, the price dropped to $2 and the owners increased the company's nominal capitalization to $1 million divided into 10,000 shares. [28] Hall was given 3,500 shares. Hunt and his venture capital associates received 2,500 shares, with the rest going to Cole and others. [29] But the company needed to come up with $4,000 to meet an overdue note at a Pittsburgh bank. [30] The company had borrowed money from Pittsburgh lumber dealer David L. Gillespie and from the family of Pittsburgh coke and railroad investor William Thaw. [31] The owners decided to meet with Andrew Mellon and Richard Mellon at their banking firm. The Mellons told the group to come back the next day. The next morning, the Mellons surprised the aluminum company owners by saying they felt the Pittsburgh Reduction Co. needed more than $4,000 – and they offered to pay off all the company's debt and provide them with substantial working capital. [32]

Instead of a $4,000 loan, the company was persuaded to take out a $25,000 loan. On Jan. 16, 1890, Hall sold 60 shares of Pittsburgh Reduction Co. stock to the T. Mellon & Sons Bank. The bank was just beginning to move from the real estate loan business into corporate financing, and it later helped the aluminum company relocate to a site in New Kensington, outside of Pittsburgh. For their efforts, the bank took 500 shares of stock at $60 each, and the Mellon brothers took seats on the company's board of directors. This was the first major investment for the Mellons, who grew in wealth and financial influence over the next 10 years, moving into steel, shipbuilding, electrical machinery, glass, carborundum, oil, coke and aluminum. By 1914, the Mellons held about one-third of Alcoa's stock. By the end of World War I, the brothers held positions in 60 major companies, including Gulf Oil, Koppers, Carborundum and Alcoa. [33]

Nine months after securing the $40,000 loan, the Smallman Street plant was enlarged and outfitted with two new, more powerful dynamos, each capable of generating 2,500 amperes at 50 volts. By September 1890, the company was producing 475 pounds of aluminum per day, and the owners discussed plans to build a new plant not far from Pittsburgh, where the company could take advantage of natural gas and cheap coal deposits. [34] Hunt was made president and general manager, and Hall was made vice-president in charge of technical operations. The Smallman Street plant continued operating until March 1891, by which time the Pittsburgh Reduction Co. had started operating a new plant 19 miles away at New Kensington. [35]

Building new plants

The city of New Kensington was founded in 1891 along the banks of the Allegheny River northeast of Pittsburgh. The Burrell Improvement Co. first looked at the level site in 1890 and considered it a prime location for a city. The land was surveyed and a public sale was held on June 10, 1891. Thousands of people showed interest, including various industrial companies. The Pittsburgh Reduction Co. acquired a 3.5-acre property on the riverfront. [36] To meet increasing demand for aluminum, a larger reduction plant was built at New Kensington using steam-powered generators for electrical power. [37] The company produced its first aluminum metal at the new plant in November 1891. [38] The new facility boosted production to 1,000 pounds of aluminum per day by 1893 and to 2,000 pounds per day by 1894. [39]

The company also adopted a strategy of vertical integration – first establish a core smelting business, then expand downstream into fabrication and upstream into extraction, manufacture of raw materials and power production. [40] Special rolling mills were built at New Kensington to produce aluminum in strip-roll sheet and later flat sheets that fabricators could use more easily. [41] The new plant began producing a few cast aluminum products, such as teakettles, along with aluminum sheeting and raw aluminum. Over time, the plant was expanded to encompass a new facility called the Arnold Works. [42] After 1907, operating with the name Alcoa, the company continued to run a facility at New Kensington until the 1960s. A housing project in New Kensington was built for defense workers in 1941 called Aluminum City Terrace. Designed by Marcel Breuer and Walter Gropius, the project set new standards for federal housing design, following the Bauhaus School of Design. After World War II, the project was used to house displaced residents from other parts of the city. [43]

By 1894, the New Kensington plant was capable of producing one ton of aluminum per day, but the need to get away from steam-powered electrical generators to abundant hydroelectric power led the company to Niagara Falls, where it became the first customer for the new Niagara Falls power development. [44] The Pittsburgh Reduction Co. was followed by a wave of major metals and chemicals companies that relocated at Niagara Falls between 1895 and 1910. The move required a large investment by the company. [45] The company signed its first contract with the Niagara Falls Power Co. on June 28, 1893, calling for 1,500 horsepower of electricity with an option for an additional 1,000 horsepower. [46] In 1894, according to U.S. government charges in a 1937 anti-trust case, the Pittsburgh Reduction Co. compelled the new hydroelectric utility company at Niagara Falls to impose restrictive covenants preventing the utility from selling power to any other aluminum smelting company. A total of five such covenants

were made between 1895 and 1905. All the covenants had expired or were cancelled by 1921. [47]

The new aluminum reduction plant at Niagara Falls was put into operation on Aug. 26, 1895. A second plant was put into operation nearby on Nov. 21, 1895. Over the next few years, additional smelting capacity was installed at the plants. [48] The company's goal at the Niagara Works was to produce enough aluminum to make it a common metal, so the company needed to promote the use of aluminum in familiar products and compete with wood and steel. To accomplish that, the company needed to lower the cost of producing aluminum metal by improving the refining process. The effort succeeded, as the price of aluminum dropped from $8 per pound in 1888 to 36 cents per pound in 1897. [49] The new plant also was designed for doubling of capacity as the market grew. By 1907, the Niagara Falls plant had grown to three large potlines. [50] A potline is made of a number of reduction pots electrically connected in a series circuit. The size of a potline is not uniform from plant to plant – the size and type of individual reduction pots can differ from plant to plant, and the number of pots connected in a single potline can be different.

In 1903, the Pittsburgh Reduction Co. also began operating a smelter and fabrication plant at Massena, N.Y., about 80 miles east of Lake Ontario, which was powered by the St. Lawrence River Power Co. The Pittsburgh Reduction Co. bought the power company in 1904. Over the decades, the Massena facility was expanded to include a laboratory, wire and cable mills, and a railroad. [51] By 1948, the Massena smelter was capable of producing about 57,500 tons of primary aluminum per year using power from Alcoa's own generating facilities as well as from Quebec and other sources. [52] The plant's capacity grew to 125,000 tons per year by 1998. [53] By the year 2000, the Massena smelter was the oldest continuously operating aluminum smelter in the U.S. [54] The Pittsburgh Reduction Co. also built an aluminum smelter in Saint Michel, France, in 1891-1892. [55]

Investors and executives

Over the years, the Mellons became the Pittsburgh Reduction Co.'s principal bankers. Andrew Mellon became a director of the company in January 1891, and Richard Mellon became a director in September 1895. By 1920, the Mellon family held about one-third of the aluminum company's stock. Hunt, who continued to suffer from an illness he contracted during the Puerto Rico Campaign, died in 1899. Richard Mellon became the aluminum company's president, and Davis became the general manager. [56]

As a result of their enormous wealth, the Mellon brothers, sons of a judge and banker, developed a mixed reputation. Richard Beatty Mellon was born in 1858. He and his

brother Andrew were often business partners – Richard served under Andrew with the Pittsburgh-based Mellon Bank, and Richard became the bank president in 1921 when Andrew became the U.S. Treasury Secretary. Richard was president of the Pittsburgh Reduction Co. from 1899 to 1910. He also invested heavily in the Pittsburgh Coal Co., which led to clashes with John L. Lewis and the United Mine Workers. During the Great Depression, Richard started the Mellbank Corporation, a holding company that helped affiliated banks weather the Great Depression. Many of Richard's philanthropic gifts were church-oriented, with a focus on Presbyterians. In 1918, he helped organize a citizens committee to develop a citywide plan to improve planning and zoning in Pittsburgh. [57]

Andrew William Mellon was born in Pittsburgh in 1855. He took over a lumber and coal business from his father in 1872 and made it profitable. He joined his father's bank in 1880 and had the ownership transferred to himself in 1882. Andrew's largest industrial investments, in addition to the Pittsburgh Reduction Co., included a partnership with Edward Goodrich in the creation of the Carborundum Co., a partnership with Heinrich Koppers which converted coal-gas, coal-tar and sulfur waste products into usable products, and an early investment in the New York Shipbuilding Co. Andrew served as U.S. Treasury Secretary from 1921 to 1932 under Presidents Warren Harding, Calvin Coolidge and Herbert Hoover and as ambassador to the United Kingdom from Feb. 5, 1932 to March 20, 1933. [58]

By the mid-1920s, Andrew Mellon was the third wealthiest income tax payer in the U.S., behind John D. Rockefeller and Henry Ford. His wealth peaked at $300 million to $400 million in 1929-1930 while he was serving as Treasury Secretary. As head of the Treasury Department, he dealt with revising the U.S. tax system, enacting an emergency tariff act, creation of a federal budget system and addressing huge war debts accrued by France and Germany during World War I. At the beginning of Great Depression, Andrew Mellon allegedly advised President Hoover to "liquidate labor, liquidate stocks, liquidate farmers, liquidate real estate. It will purge the rottenness out of the system. High costs of living and high living will come down. People will work harder, live a more moral life. Values will be adjusted, and enterprising people will pick up from less competent people." [59]

In January 1932, fearing communist agitation when jobless men from Coxey's Army marched on Washington, D.C., President Hoover ordered an investigation and discovered the march was financed by Andrew Mellon. An impeachment hearing that followed led to Mellon's resignation as Treasury Secretary. His tax status was investigated by the Roosevelt administration in 1933-1935, but he was exonerated in the Mellon Tax Trial, which concluded several months after his death in 1937. Andrew

Mellon and his brother created philanthropic groups, one of which became the Carnegie Mellon University. He also created the Andrew W. Mellon Foundation. [60]

Hall's legacy was also felt nationwide. He had acquired a mixed reputation with members of the Pittsburgh Reduction Co. during the company's first years – he inspired respect for his simple piety and his concern over the welfare of the company's workers, and he earned Davis' loyalty. On the other hand, the company's top managers were strict businessmen with an eye on production and profit, and they regarded Hall a bit odd – a man devoted to research without practical purpose. After hiring a "personal chemist" to work with him at the company's Niagara Falls facility, Hall's research efforts wandered to pursuits that were considered alchemy by company managers – such as transmuting base metals into rhodium, platinum or gold. His secretary would explain away his work by saying, "Mr. Hall was a research man!" Hall was also a loner and even eccentric. Though once engaged to a college sweetheart, he never married and lived a frugal life in boardinghouses until he was 39. He believed in clean living and clean thinking, and he took pleasure in playing the piano in what were described as "boring recitals." [61]

In 1907, when the Pittsburgh Reduction Co. changed its name to Alcoa, Hall returned to his interests in music and art and collecting Oriental rugs and porcelain, while retaining his interest in research and development. He filed several additional patents, including one that was registered four years after his death. Hall was awarded the prestigious Perkin Medal for outstanding achievement in chemistry in 1911. [62] To the public, Hall became a symbol of industry, and he led a busy professional and public life. He served as the founder of the American Electrochemical Society and a trustee at Oberlin College, and he was active in civic affairs. He acquired a taste for the fine arts in his world travels and amassed a private collection of paintings, Chinese porcelains and Oriental rugs, most of which he bequeathed to Oberlin College along with a large portion of his estate. Hall remained devoted to Oberlin College all his life. By 1988, Hall's gift to Oberlin amounted to half the college's endowment. Portions of his estate also went to the American Missionary Association for the education of blacks in the American south and to numerous educational institutes. [63] He also gave money to Berea College and educational programs in the Balkans and Asia. [64]

In 1904, Alcoa declared a stock dividend of 100%. In 1909, it declared a stock dividend of 500%. In each instance, the par of the stock was $100 per share. In 1925, as part of the company's reorganization, each common stockholder received seven shares of preferred stock and six shares of common stock in the reorganized company. The par of the preferred stock was $100 and the par of the common stock was $5. In sum, a $100 share in Alcoa bought prior to 1904 would have been worth $8,760 by 1941. [65] In "The

True Story of Aluminum," Alfred Cowles described Hall's success story this way: "There can be little doubt that this was the greatest financial reward ever received for a single invention by anyone in the world." [66] By 1914, when Hall died of leukemia, income from his stock in the aluminum company was worth $150,000 per year. His estate was estimated to be worth $45 million, an unprecedented fortune for an inventor. Hall's estate included about 26% of Alcoa's stock, which he put in Davis' hands to control for 15 years after his death. Dividends from the stock could be paid out to the beneficiaries named in his will over those 15 years, but control over the stock, and therefore Alcoa itself, was left to Davis. [67]

Arthur Vining Davis was made president of Alcoa in February 1910. Four years later, he moved his office to New York City while the company's headquarters remained in Pittsburgh. Following World War II, Alcoa's top management shifted in names but not structure, as the older generation moved on and was replaced gradually by younger managers. Davis moved to Florida, where he invested in the real estate business. According to some accounts, Davis made more money in real estate than he ever made in aluminum. He evolved into the archetypical caricature of an aging tycoon, borrowing Alcoa managers for personal affairs and shaking up the Alcoa headquarters each time he arrived in Pittsburgh. [68]

In 1946, Davis sat as chairman on the Alcoa board with George Clapp, another survivor from the Pittsburgh Reduction Co. Despite his gruff exterior, Davis was considered a great compromiser and a realist who made things work out. [69] By 1951, Davis owned about 9.4% of Alcoa's common stock. His share fell to about 5.8% by 1956. [70] Davis retired from Alcoa in August 1957 and died in 1962. He left behind an estate estimated to be worth $400 million. Much of his wealth came from the Arvida Corporation, his real estate company, and a substantial portion of his estate went into the Arvida Foundation. [71]

Looking back at the company's first decades, Davis once recalled, "While it was a great and wonderful thing to invent the process for making aluminum, it was a totally different and as it actually turned out an infinitely more difficult problem to make aluminum commercially, and a still greater problem to utilize the aluminum when made." The company's original investors intended to create a new image for aluminum as a common metal, and for the short life of their patents, they adopted a policy of rapid expansion in productive capacity by reinvesting earnings. Only twice during the company's first 20 years were dividends paid out on its stocks. Once the industrial process of aluminum smelting was established, the company began to vertically integrate forward into fabrication, creating markets for the metal, and backward into

mining and refining raw materials, supporting the company's growing productive capacity. [72]

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