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Rubber Rampage: The Era that Produced Vulcanized Rubber

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Abstract:

Rubber, a waterproof gum, was demanded by many in the early 1830's. While useful as a waterproof, elastic fabric in its flexible state which is at room temperature, the rubber froze in the winter and turned sticky in the summer. During this era, many knew that whoever discovered the stable state would gain an abundant fortune. This is what Charles Goodyear achieved in 1839 by adding sulfur to the natural rubber; this process is now known as vulcanization. This scientific breakthrough revolutionized the automobile industry. Society had been using the iron wheel since 1000 BC which was an extremely rickety trail ride. The newly stabilized rubber absorbed the shock from the imperfections in the road in the form of a tire; thus, creating a more stable ride. This heightened the urge for the public to create gas powered vehicles. Everything about the discovery of rubber and vulcanization drove the automobile industry into the astounding business that it currently is.

Key Words: Rubber, Vulcanization, Charles Goodyear, Tires, Automobiles

Vulcanized rubber heightened the urge to create human powered and gasoline powered vehicles. The rubber tires absorb the shock from imperfections in the road; wooden wheels cannot do this, which, in turn, creates more momentum for the vehicle with rubber tires because miniscule flaws do not slow it down. As a mechanical engineering major, I am interested in the vulcanization process which led to the use of rubber tires instead of wooden wheels. This was a major jump in the evolution of cars because friction decreased and the torque increased by the amazing find that is vulcanized rubber. In my paper, I will explore the development of vulcanized rubber and the process to its stability (vulcanization).

In 1843, Charles Goodyear discovered this procedure. He was participating in what we now know as “the rubber rampage.” This rampage started because many knew that whoever discovered the stable state of rubber would gain an abundant fortune. In the early 1830’s, everyone wanted this waterproof gum from Brazil; many factories were built to meet the demands of the people.<sup>1</sup> New England manufacturers had high dreams for this elastic substance: “[Companies were] drawn by the possibility of turning pennies’ worth of rubber into goods—boots, hats, doormats, and waterproof or elasticated fabrics—that could be sold for far higher prices.”<sup>2</sup> This fever, however, ended as quickly as it had begun: “Abruptly the public had become fed up with the messy stuff which froze bone-hard in winter and turned glue-like in summer. Not one of the young rubber companies survived as long as five years.”<sup>3</sup> In a room temperature state, this product was naturally adhesive.<sup>4</sup> If someone could identify the secret to absorbing the stickiness, then rubber could be massed produce. The question came down to, who would be the first to identify the unknown substance?

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<sup>1</sup> “The Strange Story of Rubber.” N.a. Reader’s Digest. Vol 72, January 1958, p. 164.

<sup>2</sup> Guise-Richardson, Cai. *Redefining Vulcanization: Charles Goodyear, Patents, and Industrial Control, 1834-1865*. (Chicago: John Hopkins University Press, 2010), p. 361.

<sup>3</sup> “The Strange Story.” p. 164.

<sup>4</sup> Ibid

Charles Goodyear is the superior man who discovered vulcanized rubber. The journey to unearthing this process was not a simple task for him. Goodyear was born in December 1800 in New Haven, Connecticut as the first child to a hardware owner, Amasa Goodyear, and his wife. In 1817, Goodyear left his family and travelled to Philadelphia where he learned the hardware business as an apprentice for four years.<sup>5</sup> At the age of 21, he returned home where he became a partner with his father by creating Amasa Goodyear & Son. While working at this company with his father, “They manufactured metal button and spoons, scythes and clocks. Several of their other products were farm tools of steel, devised by the elder Goodyear.”<sup>6</sup> In 1824, he married Clarissa Beecher and two years later, they moved to Philadelphia where he started his own hardware company. His company thrived at first; consequently, Goodyear gave out credit too easily which led to his suspended payments to the creditors. He refused to declare bankruptcy, partially because bankruptcy would deny him the titles to his unfinished inventions. Because of his decisions, he was in and out of debtor’s prison for ten years.<sup>7</sup> In 1830, he started to take an interest in rubber while in a prison cell: “He asked his wife to bring him a batch of raw rubber and her rolling pin. Here, in his cell, Goodyear made his first rubber experiments, kneading and working the gum hour after hour.”<sup>8</sup> Once out of jail and toward the beginning of his experimenting, his Philadelphia home was often his laboratory. However, his neighbors started to complain about the smell, so a friend gave him a fourth-floor tenement bedroom for his new workshop location.<sup>9</sup> He knew a dry material needed to be added to the rubber so something

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<sup>5</sup> Iles, George. *Leading American Inventors*. (New York: Henry Holt and Company, 1912), p. 177

<sup>6</sup> Ibid

<sup>7</sup> Iles. *Leading American Inventors*, pp. 178-179.

<sup>8</sup> “The Strange Story,” p. 165.

<sup>9</sup> “The Strange Story,” p. 166.

would absorb the stickiness. While in this new location, he tried experimenting with magnesia and quicklime, but he did not get his final, remarkable product until 1839.<sup>10</sup>

In that year, he discovered the true process of vulcanization which dried not the surface alone, but the entire mass: “He was trying to harden the gum by boiling it with the sulfur on his wife’s cook stove when he let fall a lump of it on the red hot iron top. It vulcanized instantly.”<sup>11</sup> The strange substance from the jungles of the tropics had been mastered. This accident, this “eureka” moment, propelled him farther into perfecting the process right down to the exact degree of heat. By the time he had perfected it, he had so much excess rubber around his house, that he was known for the rubber that he wore. A neighbor once said, “You will know him when you see him; he had on an India rubber cap, stock, coat, vest, and shoes, and an India rubber purse without a cent in it!”<sup>12</sup> (See image on next page). Even though the years before he discovered the process and the years perfecting it were tough, never once in his documentation, did Goodyear think about quitting. He thought man should be ready for any obstacle that he faces, because if man is not ready for the world around him, he might just miss his “Newton moment.” In his autobiography, Goodyear explains,

I was for many years seeking to accomplish this object, and allowed nothing to escape my notice that related to it. Like the falling apple before Newton’s gaze, it was suggestive of an important fact to one whose mind was previously prepared to draw an inference from any occurrence which might favor the object of his research...I am not willing to admit that [my discoveries] were the result of what is commonly called accident. I claim them to be the result of the closest application and observation.<sup>13</sup>

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<sup>10</sup> Thompson, Holland. *The Age of Invention*. (New Haven: Yale University Press, 1921), p. 168

<sup>11</sup> Thompson. *The Age of Invention*, p.169.

<sup>12</sup> Thompson. *The Age of Invention*, p.170.

<sup>13</sup> Iles. *Leading American Inventors*, p. 192.

**THE ORIGINAL**  
**RUBBER STORE,**  
**UNDER GOODYEAR'S PATENT.**  
ESTABLISHED IN 1839.



Mechanic's Apron.



Fireman's Coat.

The Subscriber offers a large assortment of Rubber Goods at reduced prices.

AMONG THE VARIETY OF WATER-PROOF AND AIR-TIGHT GOODS, ARE

 <p>Officer's Coat.</p>	<p>Air Beds and Pillows, Air Cushions for Chairs, Aprons for Ladies, Aprons for Bricklayers, Fishing Mats and Caps, Baptismal Pants, Carriage and other Cloths, Coats, Capses, and Cloaks, Caps and Sou'westers, Camp Blankets, Crumb Cloths, Cookstove and Garden Hose,</p>	<p>Drinking Cups and Canteens, Games and Fish Bags, Gun Covers, Gloves and Mittens, Horse Covers, Horse Boots and Penders, Hunting and Fishing Boots, Leggins, long and short, Life Preservers and Jackets, Ladies' Elastic, Overshoes, Overalls and Pants, Rubber Cases and Combs,</p>
<p>Horse Covers, Gents' Heavy Boots, Gents' Overshoes, Ladies' Boots, Ladies' Shoes, Misses' Overshoes, Boys' Boots, Youths' Boots, Heavy Black Rubber Coats, Heavy White Rubber Coats, Leggins,</p>	<p>Paper Hands, Parlor and Foot Mats, Seaman's Ears, Suspenders and Elastic, Syringes and Breast Pumps, Travelling Bags, Table Covers, Tobacco Wallets, Toothing Rings and Toys, Wagon Covers, Undershooting for Beds, Urinal Bags, &amp;c., &amp;c.</p>	 <p>Pea Coat.</p>
<p>Door Mats, Bathing Tubs, inflated, Spitoons, Chest Expanders, India Rubber Pencils, Thumbles, Card Baskets, Ladies' Mourning Chains, Ladies' Bracelets, Breast Pins, Ear Rings, Hair Pins, Crosses, and other India Rubber Ornaments.</p>		

N. B. A beautiful article of Gentlemen's silk Reversible Coats, weighing only 12 oz. Also, a superior article of Reversible Macintosh Coats.

**C. HAYES, 26 School St., Boston.**  
UNDER REV. A. A. MINER'S CHURCH.

This depicts the first rubber store opened by C. Hayes in 1861. By the list of available merchandise, you can see that this store has everything that Charles Goodyear could imagine and more. This has entire outfits made out of rubber, along with jewelry and other water proof goods.

Source: C. Hayes, "The Original Rubber Store", 1861, Advertisement, 2.5 x 28 cm, Library of Congress, Washington D.C.

Goodyear did not believe his invention was founded based on an accident or coincidence; rather, he thought, through close observation, the discovery of vulcanized rubber happened due to application.

Five years after discovering vulcanization, he took out his patent, which is a government license giving him the sole right to make or sell the invention. He decided to sell this patent and almost sixty other patented versions of his vulcanized rubber before his death in 1860. He saw his invention applied to hundreds of uses and it gave employment to 60,000 people and produced

\$8 million worth of merchandise at the time. In today's money, that would be close to a monstrous sum of \$223 million.<sup>14</sup> After his amazing discovery, to this day, the whole civilized world uses his invention in some form or another. However, many might not know of the complex process to its stability.

The element of rubber, before the vulcanization process, is a highly elastic substance polymerized by the drying and thickening of the latex or milky juice of rubber trees and plants. Vulcanization, also called curing rubber, uses sulfur to chemically alter rubber by producing cross-links between polymer chains.<sup>15</sup> It prevents rubber from becoming plastic and sticky with heat, or brittle and inflexible with cold, and improves its resistance to solvents. Depending on the heat and quantity of sulfur used, vulcanized rubber can be lenient, elastic material or firm, non-elastic material. It took Goodyear multiple years to patent his discovery because, he too, noticed the consistencies were different when heated to different degrees of heat. Even though it took him numerous years to understand what he had found, thankfulness is given toward him because of the rubber tire industry.<sup>16</sup>

As stated above, the obvious use for rubber today is through the usage of tires. A rubber expert, John Long reports, "Rubber tires stand as the largest application of marketable rubber, capturing 70% of the rubber market and earning approximately \$160 billion a year. In 2011, 1,896,283,983 rubber tires were produced globally."<sup>17</sup> Thirty-eight years after Goodyear's death, Frank Seiberling founded the Goodyear Tire & Rubber Company. This company was visibly named after the founder of rubber himself. The corporation, really skyrocketed in the 1990's. Its stock shot through the ceiling in the first eight years of this decade by rising 1000%. As anyone

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<sup>14</sup> Thompson. *The Age of Invention*, p. 172.

<sup>15</sup> Guise-Richardson. *Redefining Vulcanization*, pp. 360-361.

<sup>16</sup> Guise-Richardson. *Redefining Vulcanization*, p. 361.

<sup>17</sup> Dim, Joan Marans. "Charles Goodyear Took the Goo Out of Rubber Recast: His Vulcanization Solidified a Product for the Ages." *Inventor's Business Daily*. Summer, 2012, p. A03.

could guess, Charles Goodyear would be proud of the industry that could start because of his patent. Even though most of today's rubber supplies goes toward the making of tires, the other 30% is used in the making of shoes, outerwear, packaging, life rafts, boats, frogman suits, rubber bands, soccer balls, fire equipment, Frisbees, planes and medical supplies.<sup>18</sup>

When the wooden wheel was created, along came the vehicle. The reason that the tire holds so much importance is due to the fact that the creation of the wooden wheel happened in fourth millennium B.C.; then the iron wheel with spokes transformed the industry for wheels in 1000 B.C. The iron wheel made its foothold in history because the wheel did not change until Goodyear discovered the stable form of rubber.<sup>19</sup> The invention of the rubber tire and the development of the automobile falls into the same time progression: "First came the wheel, then the vehicle, then the rubber tire, then the auto industry and then, finally, highways. A key figure in this progression is, of course, Charles Goodyear."<sup>20</sup> It took civilization over 5,000 years to transfer from the wooden wheel to the rubber tire. This span of time consisted of uncomfortable and rickety trail rides from the use of wooden and iron wheels; however, the idea was brilliant at the time. Vulcanized rubber, or natural rubber was also brilliant at the time, but then, World War II broke out.

In 1930, scientists were seeking better automobile antifreeze and accidentally created synthetic rubber: "Natural rubber is siphoned from cultivated trees on plantations in Asia and Africa. Synthetic rubber is man-made and is produced around the world in manufacturing plants that synthesize it from petroleum and other minerals."<sup>21</sup> Synthetic rubber is also oil proof unlike

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<sup>18</sup> Ibid

<sup>19</sup> Tudor Raiciu. "History of the Wheel." Last Modified, June 2, 2009. <http://www.autoevolution.com/>. Last Accessed, November 20, 2013.

<sup>20</sup> Dim. "Charles Goodyear Took the Goo." p. A.03.

<sup>21</sup> IISRP. "What is Synthetic Rubber." Last Modified August 16, 2010. <http://www.iisrp.com>. Last Accessed, November 20, 2013.

natural rubber.<sup>22</sup> Scientists in Germany took this new rubber and reformulated it to hold thirteen times more air than natural rubber and it resisted aging, weathering, chemicals, moisture, and tearing. As war broke out, Franklin D. Roosevelt decided to regulate the usage of natural rubber by the American people: “Franklin Roosevelt, calling rubber a “strategic and critical material,” created the Rubber Reserve Company (RRC), to stockpile natural rubber and regulate synthetic rubber production. Firestone, B.P. Goodrich, Goodyear, and U.S. Rubber agreed to work together to solve the nation’s wartime rubber needs.”<sup>23</sup> This event happened with respectable timing because just months later, Japan moved to conquer Southeast Asia and 90% of the world’s natural rubber suddenly became unavailable to the United States; Americans no longer had access to natural rubber so they became dependent on the usage of synthetic rubber. The reason World War II plays a huge role in the development of rubber is once citizens started using synthetic rubber, they never went back to natural rubber: “In 1940, only .4% of the rubber used by American companies was synthetic. Production of one type of synthetic rubber increased in the U.S. during the war from 3,721 tons in 1942 to 756,042 tons by 1945. By 1950, the use of synthetic rubber outpaced natural rubber. Today more than 70% of rubber production utilizes synthetic rubber.”<sup>24</sup> To this day, the United States primarily uses synthetic rubber.

The analogy, beads on a chain, as portraying history without a sense of causality, does not apply in the timeline of rubber. We used this parallel in History 251 quite often, because it was the way many used to understand history. While researching this topic, I finally understood the underlying message of said analogy. Every event that transpired throughout history did not happen randomly; the actions made before are what led to any proceeding studied today.

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<sup>22</sup> “Rubber-A Vital WWII Commodity.” *National World War II Museum*. [www.nationalww2museum.org](http://www.nationalww2museum.org). Last accessed, November 20, 2013.

<sup>23</sup> Ibid

<sup>24</sup> Ibid



Everything about the discovery of rubber and vulcanization drove the automobile industry into the astounding business that it currently is. In turn, this led to irrevocable, yet amazing changes in American society as a whole.<sup>25</sup> The world goes from using rubber as a ball, to tires, which advanced the automobile industry, and then, the highway system was created. This way of traveling is the foundation of the way Americans live yet today. The rubber used to progress the wheel helped change our lives for the better. We can now explore a majority of the world in our lifetime, because of the simplicity of travelling, thanks to Charles Goodyear.

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<sup>25</sup> See also, L.J.K Setright, *Drive On! A Social History of the Motor Car* (London: Granta Books: 2004).  
See also, Michael L. Berger, *The Devil Wagon in God's Country: The Automobile and Social Change in Rural America, 1893-1929*. (Hamden, CT: Archon Books, 1979).

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