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Women in Transportation:

Changing America's History

Reference Materials

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TABLE OF CONTENTS

Introduction 1

Walking Toward Freedom 2
Harriet Tubman 2

Maritime Pioneers 3
Martha Coston 3
Mary Patten 3
Ida Lewis 4
Thea Foss 5

Other Women and the Water 7
Nettie Johnson 7
Mary Miller 7
Callie French 7
Mary Becker Greene 7
Lydia Weld 7
Mary Converse 7

Traveling Journalists 8
Nellie Bly 8
Eliza Ruhamah Scidmore 8

Balloonists 10
Mary Myers 10
Aida de Acosta 10
Jeannette Piccard 10

Early Civil Engineers 11
Emily Warren Roebling 11
Elizabeth Bragg Cumming 11
Elimina Wilson 12

Women Behind the Wheel 13
Anne Bush 13
Alice Huyler Ramsey 13
Janet Guthrie 13

Paving the Way in Transit 14
Helen Schultz 14

Working on the Railroads 15
Mary Walton 15
Olive Dennis 15

Taking Off 16
Harriet Quimby 16
Amelia Earhart 16
Bessie Coleman 18
Willa Brown 18
Jacqueline Cochran 18
Phoebe Fairgrove Omlie 19
Katherine Stinson 19
Louise Thaden 20
Linda Finch 20

Women During World War II:
Rosie the Riveter 22

Urban Design and Livable Communities 24
Jane Jacobs 24

Chemical Engineers 26
Katherine Burr Blodgett 26
Stephanie Louise Kwolek 26
Edith M. Flanigan 26

Other Contributions in Science
and Technology 28
Mary Engle Pennington 28
Helen Blair Bartlett 28
Gertrude Rand 29
Elsie Eaves 29
Ivy Parker 29

Traveling in Space 30
Sally Ride 30
Other Astornauts 30

Women Administrators in Transportation .....
Beverly Cover 31
Judith A. Carlson 31
Karen M. Porter 31
Mary Anderson 31
Alinda C. Burke 31
Elizabeth Dole 31
Carmen Turner 32

Conclusion 34
Selected Bibliography 35

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INTRODUCTION

Transportation has long been considered a man's field, but throughout time, women have made significant contributions to the transportation industry and laid the groundwork for future innovation. Women have worked in every mode of transportation, and in every type of job, from legislative and managerial positions to maintenance work. Since the time when travel was dominated by walking, horse-drawn carriages, and sailing ships, through the era of the railroads and automobiles, and now as aviation pushes into the frontiers of space, women have been part of the innovations, explorations, and manufacturing of transportation. Moreover, women have made these contributions to the transportation industry and to American society despite the fact they did not receive the right to vote until the 19th amendment was ratified on August 26, 1920.

This guide describes innovative and remarkable women who have pioneered and succeeded in a predominantly male field. In this document, the coverage of different transportation modes is uneven. The easiest to find and largest quantity of research material is on women in aviation, beginning with Harriet Quimby. There is still much work to be done to research and document the many contributions women have made in this and other fields of transportation. More research needs to be conducted at the U.S. Patent Office, and the contributions of women at the major automobile manufacturers today should also be documented. We hope this resource document is only the first step in a long process to preserve the history of women in transportation.

WALKING TOWARD FREEDOM

Harriet Tubman (1820-1913)

The "underground railroad" has become a symbol of the abolitionist movement of the 1800's. Although it was not underground nor a railroad in the physical sense, the term identifies the informal system of escape routes used by southern slaves. According to a National Park Service study of the underground railroad, the system began operating with the start of slavery in the Americas during the 1500's.[1] The network extended from the southern colonies, not just north to Canada, but also into the western territories, Mexico, and the Caribbean. Although the impact of the railroad was immense, very little factual information about the system exists, because the conductors were understandably concerned with protecting themselves and the runaways. One of the best known conductors of the mid-1800's was Harriet Tubman, who helped more than 300 slaves reach freedom through the underground railroad. Tubman became known as "the Moses of her people," because like Moses, she led others out of slavery.

Born a slave, Tubman was taken away from her family and hired out three times by the time she was 10 years old. At that age, she went to work in a neighboring field, where she heard the first stories of slaves escaping by means of the underground railroad. Working in the fields, she gained the strength and physical endurance necessary to ensure success during her later journeys, leading slaves to freedom from the South to the North. Although she married a free man, John Tubman, in 1844, she remained a slave, because marriage did not alter her slave status.[2]

In 1849, Tubman was sold to a slave trader; uncertain of her future, she escaped into the woods one night at dusk. She traveled during the night and slept in the barns and shacks of people who participated in the underground railroad during the daytime. She made her way to Pennsylvania and found work as a scrubwoman and cook in Philadelphia.

In Philadelphia, she concentrated on devising a plan that would help other slaves reach freedom in the North. In addition, she became an abolitionist, associating with such individuals as William Still, leader of the underground railroad, and Thomas Garrett, a white abolitionist. With their help, Tubman became an active agent of the railroad.

In December of 1850, Tubman learned that several of her sisters had escaped from the plantation where they had grown up. She went to Maryland and guided them to freedom through the railroad's network of safe havens. The following spring, she repeated the journey to help her brother and two other men travel north.

Tubman continued making these trips. Her efforts brought many men, women, and children to sanctuary in the North and in Canada. By 1858, plantation owners had joined forces to offer a $40,000 reward for the capture of Harriet Tubman, based on rumors that she had helped 300 people escape to the North via the underground railroad.

The Emancipation Proclamation, followed by ratification of the 13th amendment, ended slavery in the United States, but Harriet Tubman's efforts did not end. She spoke beside Susan B. Anthony and Elizabeth Cady Stanton, advocating women's suffrage and the right to control property.

Harriet Tubman died in her home at the age of 93 on March 10, 1913. She displayed bravery unequaled by any other woman of her time. Her courageous and fearless leadership transformed, not only individual lives, but an entire society. She never lost a life on her numerous trips to bring slaves to freedom, which was, in itself, remarkable. Tubman's dreams of freeing other slaves first came to her after her journey to Pennsylvania. When she arrived on free soil, she felt as if she was in heaven. She wanted others to experience the same feeling of freedom, and her courage helped others make those dreams come true.

MARITIME PIONEERS

Martha Coston (1826-?)

Martha Coston was a prominent Washington socialite who was widowed at age 21. She met the challenge of providing for herself and her children by inventing a system of maritime signal flares. Starting with an unworkable idea she found in her late husband's notebooks, Coston eventually created signal flares that were sufficiently bright and long lasting to allow ships at sea to communicate with other ships or land bases through a code based on color combinations. Coston relied on her husband's reputation by applying for the initial patent as his administrator[3] and received patent #23,536 for her system, known as Coston's Telegraphic Night Signals, in 1859. Later patents for system refinements were in her own name.

The signals came with charts and directions for using the flares and an explanation of the symbols represented by each color and combination of colors. The colors of the small signals could be clearly distinguished from a distance of 4 to 6 miles, and the colors of the large signals could be seen and distinguished from 6 to 10 or 15 miles.

Coston's efforts were rewarded in February 1859 when C. S. McCauley, captain and senior officer of the United States Navy, and others wrote in a letter to the Honorable Isaac Toucey, then Secretary of the Navy, "the Coston Signals are better than any others" known at that time. The correspondents added that the Coston signals "offer precision, fullness, and plainness."[4] Coston sold her system to the Navy for $5,000.

After obtaining European patents on the signals, Coston sold her U.S. patent rights for the original system to the U.S. Navy for $20,000, while arranging to continue their manufacture for the Navy. Later refinements, including a twist-ignition device patented in 1871, allowed Coston to sell the system to navies, shippers, and other maritime-related industries and groups around the world.[5] The system was adopted by the governments of France, Italy, Denmark, the Netherlands, and Haiti. As of the late 1970's, the Coston Supply Company, established by Coston, was still in business. The system revolutionized naval communication and its use continues today.

In the introduction to her autobiography, entitled A Signal Success, Coston stated that, in developing and perfecting the Coston signals, she was inspired by the "intense and heartfelt desire to accomplish something for the good of humanity." She wanted to "in some way lighten the load of watching and responsibility that rests on the shoulders of the brave mariner and to place in his hands the means of saving not only property but precious human life."[6]

Coston clearly demonstrated that, with "integrity, energy, and perseverance, they [women] need no extraordinary talents to gain success and a place among the world's breadwinners"; however, she also noted that she had to be "ready to fight like a lioness" to avoid being undercompensated or dismissed because of her sex. Coston was acutely aware of her nontraditional position as a female inventor and businesswoman, and her autobiography includes the observation, "[w]e hear much of chivalry of men towards women, but...it vanishes like dew before the summer sun when one of us comes into competition with the manly sex."[7]

Mary Patten (1837-1861)

As the wife of a clipper ship captain, Mary Patten learned navigation during the 101-day maiden voyage of Neptune's Car in 1855. At that time, it was customary for captains to bring their wives with them when sailing their clipper ships, despite the acknowledged danger of crew revolt as a result of poor food, low wages, and harsh working conditions. Patten put her navigational skills to good use during her next and last voyage to sea as the only woman to take command of a clipper ship.[8]

In July 1856, Neptune's Car set sail for San Francisco with 26-year-old Captain Joshua A. Patten in command and his wife, Mary, also aboard. The gold fields of California and the West had opened in 1848, drawing

New Englanders to try their luck. Intended to be one of the fastest clippers afloat, Neptune's Car was a giant at 66 meters (216 feet) and 1,632 metric tons (1,616 tons). Speed and size were important, because competition was stiff among the clipper ships. Crewmembers often placed bets on which ships would return to port first and would then try to sabotage the progress of their own vessels to win the bets. Apparently, trouble started early on Neptune's Car, when Captain Patten discovered that his first mate was sleeping on watch and keeping the ship under reefed sail to slow its progress. Eventually, the first mate was placed in irons to minimize disruption of the crew.

The loss of a watchkeeper and his refusal to delegate the first mate's duties to another officer forced Captain Patten to remain on duty constantly during the passage around Cape Horn. According to newspaper accounts of the day, "the Neptune's Car was off Cape Horn 18 days with strong westerly gales." Captain Patten fell ill before the ship cleared the storms off the Cape. Completely exhausted, he told his wife his head ached and he felt feverish.

The ship's medical book provided little help, because the captain was suffering, not from pneumonia, but from an illness known as brain fever, which is characterized by periodic blindness and deafness alternating with periods of complete insensibility and bouts of feverish raving. Mary Patten found herself in an explosive situation.

Fending off the first mate's demand to be restored to authority, Patten informed Mr. Hare, the second mate, who was a good sailor but unable to navigate, that she would take command of the vessel and navigate the ship to San Francisco. For the next fifty days, Patten was so involved with the responsibilities of command and caring for her husband that she took little time for sleep or to care for herself, despite being pregnant with her first child. According to the New York Daily News of
March 18, 1857, the crew supported her efforts after watching her make the twice daily navigational observations necessary to maintain the proper course and continuing to study the medical books for a cure for her husband.

Patten was partially successful with both tasks. By the time the ship was nearing the vicinity of Valparaiso, her husband had recovered somewhat. He relapsed shortly after formally deposing the first mate for continued attempts to delay arrival in San Francisco. Mrs. Patten continued to navigate the ship up the Chilean coast, taking full advantage of the winds. Unfortunately, a week's sail out of San Francisco, the wind died, leaving Neptune's Car lagging off the coast for 10 days in the summer heat. Finally, Neptune's Car made port under a light breeze. Mrs. Patten noted in the log that the journey had taken 136 days.

The publicity stemming from newspaper accounts of the journey raised sufficient funds for Mrs. Patten to return with her husband to New England on the steamer George Law. A letter from the Atlantic Mutual Insurance Company, insurers of Neptune's Car, praised her efforts, saying that the company knew of no instance "on record where a woman has been called upon to assume command of a large and valuable vessel, and exercised a proper control over a large number of seamen, and by her own skill and energy impressing them with a confidence and reliance making all subordinate, and obedient to that command."

Lauded by the press and feminists, Patten continued to focus on her husband's care. She gave birth to a son, Joshua Adams Patten, on March 10, 1857. In July, Captain Patten died from his illness. Worn down by his care and the birth of her son, Mrs. Patten never recovered from the rigors of her historic voyage. Mary Patten died in 1861 at age 24.

Ida Lewis (1842-1911)

Idawalley Zorada (Ida) Lewis became a nationally acclaimed heroine in 1869. The act of bravery that put her in the public eye was her rescue of two soldiers from the icy waters of Newport Harbor during a snowstorm. As the best known lighthouse keeper of her day, Lewis is officially credited with 18 rescues during the 58 years she tended the Lime Rock Beacon outside Newport Harbor.

Lewis began tending the lighthouse four months after her father, Captain Hosea Lewis, became its keeper. Lighthouse keeping was an extremely well paid position for the times. The Government provided a good annual salary, well built housing, and basic food stuffs and other supplies annually; therefore, when her father had a stroke, Ida took over the light-tending responsibilities to maintain the family's income. Beyond the everyday tasks of cleaning the lamp and reflectors and checking the fuel level during the night, she also became proficient at handling a rowboat, because the lighthouse could be reached only by boat.

Lewis' first official rescue was of four young men whose small boat had capsized. On another occasion, she used her dory to lead a schooner in distress to safety. Her most unusual rescue involved three shepherds who were attempting to save a prize sheep; after rescuing the men, Lewis towed the sheep to shore as well. Her 1869 rescue of the two soldiers resulted in tremendous publicity.

After the rescue, one of the soldiers presented Lewis with a gold watch, and she received the Congressional Medal for lifesaving. Both President Ulysses S. Grant and Vice President Schuyler Colfax traveled to Lime Rock specifically to meet Lewis. During the Independence Day celebration, the citizens of Newport awarded Lewis the Rescue, a mahogany boat with gold-plated oarlocks and red velvet cushions. She became the highlight of Newport's Independence Day parade as she traveled through the streets in her boat, which was equipped with wheels for the occasion.

Lewis did not become the official lightkeeper at Lime Rock until 1879. She continued at her post until her death in 1911. Her last recorded rescue was at age 63, when a close friend fell overboard while rowing out to the lighthouse. Lewis launched her lifeboat and hauled the woman aboard with all the vigor of youth. Officially, she is credited with 18 rescues; unofficial counts are as high as 25. Among the honors she received during her lifetime were the U.S. Life-Saving Service's 1881 award of its first gold medal[9] and the award in 1906 of a lifetime pension from the Carnegie Hero Fund.[10] Since her death, the Rhode Island Legislature changed the name of Lime Rock to Ida Lewis Rock, and the U.S. Life-Saving Service honored her by renaming the Lime Rock Beacon as the Ida Lewis Lighthouse. Lewis is the only lightkeeper to be honored in this way. More recently, the first of a new class of U.S. Coast Guard buoy tenders was named the Ida Lewis; the ship was launched in 1995 and commissioned in 1997.

Thea Foss (1858-1927)

Starting in 1889, Thea Foss parlayed a $5 investment in a rowboat into an oceangoing tugboat business that remains active today.[11] Born in 1858 in Eidsberg, Norway, Thea immigrated to the United States in 1881 to join her fiancé Andrew Foss, in St. Paul, MN. The harsh winters in Minnesota caused Andrew's health to deteriorate, so the family moved to Tacoma, WA, in 1889. Because carpentry and boatbuilding jobs were scarce in Tacoma, Andrew went to work in a shipyard a day's sail away.

During his absence, Thea scraped together every penny she could find, which amounted to $5 in coins, and bought her neighbor's rowboat for roughly half its value. After cleaning and sprucing the boat up with green and white paint, she sold it for $10, then turned around and bought more boats for resale. Thea operated the business out of her one-room floating home, which had been built by Andrew. When she could afford to keep the rowboats, she began to rent them to Tacoma residents for recreational use. Andrew returned home to find that his wife had made more money in two weeks than he had in two months at the shipyard. He then began building rowboats for the business.

Recreational rowboats remained popular in Tacoma until the advent of the automobile. In an effort to move with the times, the Foss family shifted focus from recreation to providing supplies for sailing ships and water taxi services for crewmembers. The Foss Maritime Company entered the tugboat business in 1912 and remains in business today. The company continues to use Thea Foss' original green-and-white color scheme for all its ships and has retained her motto, "Always Ready."

The waterway on which Thea Foss began her venture is now known as the Thea Foss Waterway. In May 1990, she and her husband were inducted into the National Maritime Hall of Fame for their contributions to our American marine heritage. Earlier in 1990, they were inducted into the Puget Sound Business Hall of Fame.

OTHER WOMEN AND THE WATER

Nettie Johnson

The first woman to be licensed as a master on the inland waterways, Nettie Johnson owned a small steam packet in the 1870's. With her husband as pilot, Captain Johnson pioneered operations on the Ohio River. She remained active through World War I, when she helped transport war supplies.[12]

Mary Miller

Mary Miller, the wife of a Kentucky steamboat man, became a licensed pilot on the Ouachita River in 1884. She gained practical experience in navigation while traveling with her husband along the rivers. In 1882, the Millers sailed their steamboat to New Orleans to enter the Oauchita River trade. When Captain Miller became incapable of command, Mrs. Miller passed the examination for her license and carried on.[13]

Callie French

Callie French was a licensed river pilot on the Mississippi and Ohio Rivers in 1888. By 1895, her license covered almost all the navigable waterways in the region and she had earned her master's license.[14] Working with her husband, Mrs. French specialized in running showboats.[15]

Mary Becker Greene (1868-1949)

Mary Becker Greene received her riverboat pilot's license in 1896, earning captain's rank in 1897. She helped manage and operate her husband's riverboat company, the Greene Line, which ran a fleet of packet boats carrying passengers and freight on the Ohio and Mississippi Rivers. Greene died aboard the Delta Queen in 1949. The company continues to operate today as the Delta Queen Steamship Company.[16]

Lydia Weld

After attending Bryn Mawr, Lydia Weld studied naval architecture at MIT, graduating in 1903. She was initially employed by a Virginia shipbuilder as a naval ship designer. Although she became an associate member of the American Society of Mechanical Engineers in 1915, she did not become a full member until 1935. Weld retired in 1917 because of ill health.[17]

Mary Converse (1872-1961)

Between 1938 and 1940, Converse logged more than 48,000 kilometers (30,000 miles) during four sea voyages in order to renew the pilot's license she had earned 30 years previously. In 1940, at the age of 68, she became the first woman to earn captain's papers (for yachts of any tonnage) in the U.S. Merchant Marine.[18] During World War II, Converse taught navigation to Naval Reserve officers. She made several unsuccessful attempts to have the working changed from "he" to "she" on the scroll licensing her to command crafts.[19]

TRAVELING JOURNALISTS

Nellie Bly (1865-1922)

Elizabeth Cochrane Seaman was a journalist who wrote social commentary urging reform of the conditions poor women faced in their workplaces and in charitable institutions. She wrote under the pen name "Nellie Bly," a pseudonym she received from a Pittsburgh editor who took the name from a Stephen Foster song.

Bly began writing as a teenager for the Pittsburgh Dispatch to support herself following her father's death. In 1887, she left Pittsburgh for New York. Her novel ideas, coupled with her perseverance and enthusiasm, enabled her to land a job at The New York World. Her first assignment was to feign insanity in order to be committed to the Blackwell's Island asylum. From this experience, Bly was able to expose the mistreatment of patients, which led to a grand jury investigation and the ultimate reform of the asylum.

Bly continued to use undercover investigations to expose the conditions of working women in various factories, shops, and prisons. She had herself arrested for theft to expose the environment in women's prisons; masqueraded as an invalid to investigate free medical care; worked in department stores and factories to experience the plight of underpaid employees; and posed as an unemployed servant to reveal employment agency practices. In essence, Bly pioneered the concept of investigative reporting.

Despite all her accomplishments as a champion of the poor working woman, Bly's greatest achievement came in 1889 when, at the age of 24, she raced around the world in an attempt to beat the record of Phineas Fogg, the fictional hero of Jules Verne's romance novel Around the World in Eighty Days. Traveling alone and with nothing more than what she was able to fit into one small piece of luggage, Bly was determined to beat the 80-day record. She set sail from the Hoboken Pier in Jersey City on the morning of November 14, 1889, at exactly 9:40 a.m. She completed her trip around the world on January 25, 1890, at 3:51 p.m., exactly 72 days, 6 hours, and 11 minutes from the day she began. Jules Verne sent her a cable with one word, "Bravo!"[20]

Joseph Pulitzer, owner of The World, promoted Bly as a front-page heroine, "personifying the independent American girl, the fascination of travel and the excitement of journalism."[21] Most stories about Bly's journey were written by other reporters, because she was busy traveling; however, on her final dash from California to New York by train, she dictated notes of her adventures for publication. During her trip, Bly traveled by various modes, including steamship, railroad, rickshaw, and sampan. The trip was important, because it showed Americans that travel abroad was safe and exciting, even for a woman. Moreover, the success of Bly's trip was an indication that long-distance travel was fast. This event also marked the first time that a national celebrity was used to advertise a variety of products, from clothes, to games and toys, and soaps.

Bly continued her journalism career for five more years after her around-the-world stunt, writing to expose poor social conditions across the country, until she married Robert Seaman. She died in 1922, but the contributions she made to American society continue to be acknowledged.

Eliza Ruhamah Scidmore (1856-?)

As an explorer and travel writer in the late 1800's, Eliza Scidmore is best known for her vivid descriptions of the voyage of the first passenger ship, the Idaho, up the Inside Passage to Alaska in 1883. Her book, Alaska: Its Southern Coast and the Sitkan Archipelago (Boston: D. Lothrop, 1885), was viewed as the ultimate travel guide for Alaska and continues to be used by tourists in the region. The Scidmore Glacier in Glacier Bay National Park is named for her.[22] Scidmore's frequent trips to Alaska, which resulted in insightful articles in newspapers and magazines across the United States, led to a jump in tourism to the territory. From 1884 to 1890, the number of visitors to Alaska increased from 1,650 to over 5,000.[23]

Scidmore traveled in the Far East as well, becoming a recognized expert on the Orient. She wrote China: The Long-Lived Empire in 1900. Her first visit to Japan in 1885 led her to propose that Japanese cherry trees be planted in Washington, DC, as a symbol of friendship between the two nations. In 1909, First Lady Helen Taft, who had lived in Japan, responded to the proposal with enthusiasm. In 1912, 3,020 cherry trees of 12 varieties were donated by the City of Tokyo and planted around the Tidal Basin, on the White House grounds, and in East Potomac Park. About 1,000 of the original trees continue to bloom; others have been replaced over the years to perpetuate the beautiful cherry blossoms every spring.

Scidmore's insightful travel journalism and photography ultimately led to her invitation in 1888 to join the National Geographic Society. She joined the Society as its first female officer and later became the first woman elected to its Board of Managers. Scidmore's work was so admired by the Emperor of Japan that, after her death, her ashes were carried to Japan and buried there.[24]

BALLOONISTS

Mary Myers

Mary Breed Hawley Myers became the first American woman credited with piloting her own balloon on July 4, 1880, in Little Falls, NY. Billing herself as "Carlotta, the Lady Astronaut," Myers completed more balloon ascents between 1880 and 1890 than any other then-living person in the world. She collaborated in many of her ventures with her husband, Carl, a mechanically gifted aeronautics pioneer. Together, they conducted experiments, gave ballooning demonstrations, and patented a balloon glide-control device that they claimed gave them some control of the balloon's movements. Myers saw nothing unusual in her activities, attributing their success to her knowledge of balloon construction, the steering device, and her good health.[25]

Aida de Acosta

At the helm of a dirigible just outside Paris on July 9, 1903, Cuban-born American Aida de Acosta preceded the Wright brothers into the air by five months. Coaehed by Alberto Santos-Dumont, the Brazilian dirigible designer, de Acosta piloted the craft from Paris to Bagatelle, following hand signals from Santos-Dumont as he bicycled below her. She landed on a polo field, interrupting an important game between the United States and England. Despite dire warnings from friends at the game and the crowd's objections, de Acosta returned safely to Paris in the dirigible after the game.

This initial use of a guided aircraft by a woman caused considerable outrage in the press and sent de Acosta's parents into shock, because they believed the adage that a lady's name should appear in newsprint only twice: when she is married and when she dies. The negative publicity and parental outrage caused Santos-Dumont to conceal the identity of the pilot, describing her only as "the heroine, a young and very pretty Cuban, prominent in New York Society" in his book Dans L'Air. Helen S. Waterhouse, aviation editor for the Akron Beacon Journal, wrote a full account of the story in Sportsman Pilot in July 1933.[26]

Jeannette Piccard (?-1981)

Atmospheric reasearcher Jeannette Piccard held the women's altitude record for her balloon ascent on October 23, 1934, until Valentina Tereshkova entered outer space in 1963. The balloon, which measured 16,990 cubic meters (600,000 cubic feet) and was filled with hydrogen, had been used to promote the 1933 World's Fair. Piccard guided the craft to 17,550 meters (57,579 feet, slightly less than 11 miles), while her husband, Jean, conducted scientific measurements inside the gondola. Taking off before a crowd of 40,000 in Dearborn, MI, the couple landed, shaken but unharmed, eight hours later and 300 miles away in Cadiz, OH. To Jeannette's sorrow, the balloon was damaged in the landing.

Before the flight, the Piccards had decided that the success of their research depended on having a reliable pilot in control of the balloon. As Jeannette pointed out in a later interview, "How much loyalty can you count on from someone you hire?"[27] Jeannette took her first flight on May 15, 1934, and soloed a month later.

The decision that Jeannette should be the one to obtain the pilot's license created problems when the Piccards attempted to raise funding for their efforts. Traditional backers of scientific research wanted nothing to do with sending a mother into danger. The couple eventually obtained the donation of the balloon and raised sufficient funds through private backers.

Jeannette Piccard later became the first woman to be ordained a minister by the Episcopal Church.[28]

EARLY CIVIL ENGINEERS

Emily Warren Roebling

When the Brooklyn Bridge was opened on May 24, 1883, it was heralded as one of the most important construction projects of the 19th century. At the opening ceremonies, Congressman Abram S. Hewitt praised Emily Roebling with these words:

> . . . this bridge will ever be coupled with the thought of one, through the subtle alembic of whose brain, and by whose facile fingers, communication was maintained between the directing power of its construction and the obedient agencies of its execution. It is thus an everlasting monument to the self-sacrificing devotion of woman, and of her capacity for that higher education from which she has been too long debarred. The name of Mrs. Emily Warren Roebling will thus be inseparably associated with all that is admirable in human nature, and with all that is wonderful in the constructive world of art.[29]

Despite Congressman Hewitt's praise and her name on the commemoration plaque, very few people realize the important role Emily Roebling played during construction of the Brooklyn Bridge. During the project, Colonel Washington Augustus Roebling, Emily's husband and chief engineer, was involved in building a caisson, which is a sealed enclosure that enables underwater construction. In this case, the Manhattan caisson was 24 meters (78 feet) beneath the high-water mark of the river. During the work, Colonel Roebling fell victim to the bends, or caisson disease, the nemesis of caisson workers worldwide at the time. The bends left Colonel Roebling virtually paralyzed, partly blind, deaf, and mute. Because she was the only person able to communicate with him, Roebling's wife, Emily, became his most important assistant.

At the beginning of Roebling's illness, Mrs. Roebling's primary duties were to care for him, while maintaining good public relations about his health and the future success of the bridge. As Colonel Roebling's health continued to deteriorate, he became "the man in the window," watching construction through a spyglass, and Mrs. Roebling served as his eyes and ears on the construction site.[30] Colonel Roebling began to write a comprehensive and detailed set of instructions for the completion of the bridge, which Mrs. Roebling used as the basis for overseeing the ongoing construction.

To retain control of the bridge project, Colonel Roebling taught his wife higher mathematics, including the calculation of catenary curves, strength of materials, stress analysis, bridge specifications, and the complexities of cable construction.[31] Although her training was informal, Mrs. Roebling is considered the first woman engineer, and she was, in essence, in charge of the day-to-day construction of the Brooklyn Bridge. Without official position or title, Mrs. Roebling was surrogate chief engineer for the bridge between 1872 and its opening in 1883.

In 1883, before the bridge opening, Mrs. Roebling became the first woman to address the American Society of Civil Engineers, successfully arguing against her husband's formal removal as the director of construction for the bridge.

Elizabeth Bragg Cumming (? - 1929)

Elizabeth Bragg became the first woman in the United States to receive a civil engineering degree when she graduated from the University of California at Berkeley in 1876, one of the 30-member class. Her thesis was entitled "Solution of a Peculiar Problem in Surveying." After graduation, Bragg married George Cumming and apparently never worked as an engineer. The California Alumni Fortnightly, v. XI, no. 5, March 1918, included an article on "Women of the University" by Aurelia Henry Reinhardt, in which Mrs. Cumming is described as "known for her participation in civic work of the most useful kind." Mrs. Cumming died on November 10, 1929.

Elmina Wilson

In 1892, Elmina Wilson graduated from the Iowa State College civil engineering program. She went on to become the first female instructor at the college until she withdrew in 1905.[32]

WOMEN BEHIND THE WHEEL

Anne Bush (?-1962)

In 1900, Anne Rainsford French Bush, apparently the first woman to receive a license to drive a car, obtained a "steam engineer's license," which entitled her to operate a "four-wheeled vehicle powered by steam or gas." She died in 1962 and is buried in Concord, MA.[33]

Alice Huyler Ramsey (1887-1983)

As the first woman to drive coast-to-coast, Alice Huyler Ramsey transformed herself from a 22-year-old housewife and mother from Hackensack, NJ, into an automobile adventurer. In 1909, one year after Ford Motors brought out the Model T, the Maxwell-Briscoe Company used Ramsey in its promotion of the Model AA as a suitable car for families of modest means.

Starting out from Manhattan on June 9th, Ramsey and three nondriving female companions reached San Francisco 59 days and 6,115 kilometers (3,800 miles) later with no maps and very few paved roads. In her book, Veil, Duster and Tire Iron, Ramsey tells of crossing Wyoming where, "if we got lost, we'd take to the high ground and search the horizon for the nearest telephone poles with the most wires. It was a sure way of locating the transcontinental railroad which we knew would lead us back to civilization."[34]

After her expedition, Ramsey began capturing headlines by frequently defeating men in car races held in cities or at county and State fairs. Eventually, she was banned from the newly forming race car associations. Despite the ban, Ramsey continued to challenge male drivers to races, which she frequently won.

Janet Guthrie (1938-)

Born on March 7, 1938, Janet Guthrie followed a diverse career track on the way to becoming the first woman to compete in the Indianapolis 500. Before becoming a race car driver, Guthrie worked as a pilot, flight instructor, aerospace engineer, technical editor, and public representative for major corporations. She had been on the sports car road-racing circuit for 13 years before being invited to test a car for Indianapolis in 1976, the same year she became the first woman to compete in a NASCAR Winston Cup race. On May 7, 1977, she became the first woman to qualify for (by setting a qualifying lap-speed record), and compete in, the Indianapolis 500. For her role in opening professional motorsports to women, Guthrie has been honored as one of the first to be inducted into the Women's Sports Hall of Fame and by the 1997 Specialty Equipment Market Association's Salute to Women in Motorsports.[35]

PAVING THE WAY IN TRANSIT

Helen Schultz

In the United States, the bus transportation industry began in the 1910's and the 1920's, mostly as a small-scale, family enterprise. Those who entered the early business faced fierce competition, poor trade prospects, inadequate vehicles, bad roads, and daredevil attitudes. Pioneers in the business were usually men, and the few women in the industry inherited the companies from their husbands, fathers, or other relatives.

Helen Schultz established the Red Ball Transportation Company in 1922. She encountered a number of challenges in the early days of bus transportation. First, she had to secure capital of $500 for a vehicle alone. She also needed a reserve sum to cover the monthly payments on the bus and pay her drivers, advertise in the local newspapers, and rent an office and bus depot. To cover the operating costs, Schultz hoped the bus line would quickly return some income. She received loans from various banks and purchased a bus from White Manufacturing. Schultz started local operation in April 1922 using word-of-mouth publicity. She began with two round trips daily between Charles City and Waterloo, IA. There were designated stops, but the bus also picked up people that flagged it down along the way.

Days after the first run of the bus, Schultz's operation had a serious problem. Heavy rain broke up the dirt road her bus traveled on. The bus was stranded for two weeks with mud up to its axles. The bus driver quit, and Schultz was in desperate need of a solution. After the rain subsided and the road dried up, Schultz hired a full-time driver to make the bus runs and gradually built up a clientele that consisted primarily of women shoppers and traveling salesmen.

Schultz defeated the weather and emerged from the mud of 1922 with her company still intact; however, by the fall of 1923, the Red Ball Transportation Company was heavily in debt. Schultz began to capitalize on her newsworthy image as an attractive, young woman fighting the mighty railroad corporations. A local newspaper, the Des Moines Register, named Schultz the "Iowa Bus Queen."

Nonetheless, the Red Ball Transportation Company continued to have serious financial troubles. In June 1930, Edgar Zelle offered to buy the company for $200,000. Schultz agreed to the price and retired from the bus business.

WORKING ON THE RAILROADS

Mary Walton

Reacting to the rampant air and noise pollution that resulted from the Industrial Revolution, Mary Walton made major technical contributions that improved the quality of life in New York City.[36]

In 1879, Walton received patent #221,880 for a method of deflecting smokestack emissions through water tanks to capture pollutants, which were then carried by the water through the city sewage system. She adapted the system for use on locomotives as well.

Later, Walton turned her attention to noise pollution. In the 1880's, many cities developed a mass transit system using elevated trains. These trains produced intolerable levels of noise as they rattled along on elevated tracks. Sociologists of the day ascribed nervous breakdowns and neuroses among some city dwellers to the increase in noise levels.

Living in Manhattan, Walton set out to solve the problem by setting up a model railroad in her basement. She used the model to develop a sound-dampening system that cradled the track in a wooden box lined with cotton and then filled with sand. After successful field trials that fitted her apparatus under the struts on existing elevated track, Walton received patent #327,422 for the system on February 8, 1881. She then sold the rights to the Metropolitan Railroad of New York City.

Olive Dennis

Olive Dennis was the Baltimore & Ohio (B&O) Railroad's engineer of service and held patents for several rail-related inventions. Dennis graduated from Goucher College with degrees in science and mathematics. She was the second woman to graduate from Cornell with a civil engineering degree and held a master's degree in mathematics and astronomy from Columbia University.

Dennis' sex made it difficult for her to find work as an engineer. Finally, on September 22, 1920, Dennis began working for the B&O Railroad designing bridges as a draftsman in the engineering department. Fourteen months later, in an effort to retain the patronage of female passengers as automobiles and intercity buses became increasingly common, the president of B&O designated Dennis the engineer of service.[37] Her responsibilities were to improve passenger service on the B&O. She rode on more than 8,000 kilometers (5,000 miles) of B&O track, covering 70,810 kilometers (44,000 miles) the first year and nearly that much each year afterwards.

Between 1920 to 1951, Dennis contributed to passenger comfort in many ways. Among her patents is the Dennis ventilator, which was inserted in the window sashes of passenger cars and controlled by passengers. Other areas to which she contributed were the inclusion of air-conditioned coaches, dimmers on overhead lights, individual reclining seats, and stain-resistant upholstery.

Olive Dennis is one of the notable women who worked in the American railroad industry. She became the first female member of the American Railway Engineering Association. During her long career with the B&O, she never felt that gender stood in the way of advancement.

TAKING OFF

Harriet Quimby (1875-1912)

Born on a farm near Coldwater, MI, on May 11, 1875, Harriet Quimby lived as an adult in California and New York, working as a journalist.[38] By 1906, she was the drama critic and woman's page editor for Leslie's Illustrated Weekly. Quimby challenged existing beliefs about appropriate behavior for women, using the Weekly as a platform to air her beliefs.

In October 1910, Quimby witnessed John Moisant's flight between Belmont Park and the Statue of Liberty during an air race. She decided to learn to fly. Undeterred by Moisant's death in a flying accident in December 1910, Quimby began flying lessons during the spring of 1911.

For a variety of reasons, including to avoid criticism and possible embarrassment for her employer, Quimby disguised herself as a man and took her lessons at sunrise. Eventually, a reporter discovered the charade, which resulted in considerable publicity and the sobriquet of "the Dresden China Aviatrix." The first official acknowledgment of Quimby's flying lessons was a May 25, 1911, article entitled, "How a Woman Learns to Fly," followed on June 22 by "Exploring the Air Lanes."

As a woman of post-Victorian American society, Quimby was hampered by society's image of proper behavior and dress. Although trousers and a man's shirt were the most practical costume for flying the planes of the era, wearing them was considered immodest and unacceptable for most women. The alternative of hobbling the voluminuous skirt about the knees was not only awkward, but uncomfortable and dangerous. Consequently, Quimby worked with a tailor to design an outfit that she believed would "establish the aviation costume for women in this country, if not the world." Appearing to be a conventional walking skirt, the final costume consisted of a one-piece purple satin outfit with full knickerbockers reaching below the knees, black knee-high lace-up boots, flying goggles, driving gloves, and a long coat for cold-weather flying.

On August 1, 1911, Quimby received pilot's license number 37. She was the first woman in America to receive her license. On September 5th, she became the first woman to fly at night. During a flying tour of Mexico, Quimby decided to become the first woman to fly the English Channel. She made the attempt on April 12, 1912, despite poor visibility due to fog and rain—an amazing achievement given the aviation technology of the time. Her success was overshadowed by news of the Titanic disaster, which had occurred the previous evening.

Harriet Quimby visualized aviation as a "fruitful occupation for women. I see no reason they cannot realize handsome incomes by carrying passengers between adjacent towns, from parcel delivery, taking photographs or conducting schools of flying."[39] Unfortunately, at the time, women aviators were seen as a novelty, not to be taken seriously, so Quimby was unable to find a job as a flight instructor. She turned to exhibition flying and was killed during a flight over Boston.

Amelia Earhart (1897-1937)

Amelia Earhart secured a place in the hearts of Americans with her daring flight achievements during the 1920's and 1930's. She opened the doors to aviation for other women by providing them with a role model. She was a pioneer, as well as an explorer of new technology.

In 1920, Earhart began as a barnstormer with Frank Hawks in Glendale, CA. Earhart began flying solo within the first year of taking lessons from Neta Snook. When her parents sold their house, Earhart's mother helped her buy her first airplane, a second-hand, bright yellow Kinner Airstar she named Canary. Amelia and Canary quickly set a new women's altitude record of 4,267 meters (14,000 feet).

In 1927, Charles Lindbergh made the first nonstop solo flight across the Atlantic. One year later, George Putnam chose Earhart to fly as a passenger on a transatlantic flight to become the first woman to cross the Atlantic Ocean by air. Exactly 20 hours and 40 minutes after leaving Newfoundland in Canada, pilot Bill Stultz, mechanic Slim Gordon, and captain Amelia Earhart landed in Wales, in the west of England. When she arrived, Earhart was greeted by only a handful of stunned farmers, not the cheering crowds that had welcomed Lindbergh; however, her flight demonstrated to the public that air travel was safe. Stereotypes of the time held that women were incapable of flying. People reasoned, therefore, that if a woman could travel by air across the Atlantic, air travel must not be dangerous. Earhart's book, 20 Hrs 40 Mins, published in 1928, recounts the journey.

With her newfound fame, Earhart bought another airplane and flew solo from New York to California and back, becoming the first woman to make a coast-to-coast return flight. Annoyed that she had not been the pilot for the flight that made her famous, Earhart set out to repeat the cross-Atlantic journey on the fifth anniversary of Lindberg's flight. She flew across the Atlantic in 14 hours and 56 minutes on May 21-22, 1932, becoming the first woman to fly across the Atlantic Ocean alone. The public response was stupendous. Earhart received the Distinguished Flying Cross from Congress, the Cross of Knight of the Legion of Honor from the French Government, and the Gold Medal of the National Geographic Society, presented by President Hoover.[40]

Earhart continued to set new flying records. In January 1935, she became the first person to fly solo across the Pacific Ocean by going from Honolulu to Oakland, CA. She set a speed record for flying from New York to Los Angeles. She also made the first-ever flight from Los Angeles to Mexico City and was the first woman to cross North America in a nonstop flight.

Between 1935 and 1937, Purdue University in Lafayette, IN, provided Earhart with a visiting faculty position to conduct research in aviation and counsel female students. To facilitate the research, the Purdue Research Foundation bought Earhart a new aircraft. In July 1936, she took delivery of Electra, a Lockheed 10E, the biggest, fastest, most powerful craft she had ever flown and the aircraft she would use for her around-the-world flight.

Earhart's attempt to circle the globe was not the first, but the equatorial route she intended to follow would make it the longest at 46,670 kilometers (29,000 miles). Earhart and her navigator, Fred Noonan, began their first attempt traveling westward from Oakland, CA, to Honolulu on March 17, 1937. A blown tire during the landing in Honolulu caused the plane to make a sudden, sharp turn, called a ground loop, and sustain severe damage.

Following repairs in Oakland, Earhart and Noonan traveled to Miami, FL, to begin the second attempt, which would take them eastward across the Atlantic Ocean, over Africa, and then across the Indian Ocean. By June 29th, the pair had successfully completed 35,400 kilometers (22,000 miles) and 23 legs of their 46,670-kilometer (29,000-mile) journey. On July 2nd, the two departed Lae, New Guinea, on the next leg of the voyage, which was 4,135 kilometers (2,570 miles) to Howland Island, a small island in the South Pacific. Hours after they were due to land, the Coast Guard cutter Itaska recorded the last transmissions from Earhart. Extensive air and sea searches have found no traces of Amelia Earhart, Fred Noonan, or their aircraft.

Amelia Earhart was a role model for women during her life and continues to inspire women and girls throughout the world. She became a charter member and the first president of the Ninety-nines, an organization founded by 99 of the 117 licensed women pilots in 1929. The original purpose of the organization was to coordinate the interests and efforts of women in aviation.[41] Her three autobiographical books and the aviation column she wrote for Cosmopolitan were immensely popular at the time.[42] Earhart became active in the fledgling commercial aviation industry. She explored new boundaries and often spoke on women's rights issues.

Bessie Coleman (1893-1926)

Like Amelia Earhart, Bessie Coleman began flying in the early 1920's, becoming the first African-American pilot. Born on January 26, 1893, in Atlanta, TX, Elizabeth (Bessie) Coleman's initial pursuit of a formal education in aviation was rejected by administrators of the newly formed aviation schools in the United States, because she was an African-American woman. White pilots refused to instruct her. To pursue her dreams, Coleman sought advice from Robert Abbot, editor and publisher of the Chicago Defender, a publication for African-Americans. Abbott suggested that Coleman go to France, which was also a leader in the field of aviation but had more liberal attitudes about women and people of color.

Armed with French lessons and her life savings, Coleman registered in the Ecole d'Aviation de Fréres Caudron, the most famous flight school in France in 1920.[43] Despite the fact that she witnessed the death of a fellow pupil during a flying test, Coleman persisted with her training, walking 14 kilometers (9 miles) to school each day for 10 months.[44] After earning her license from the prestigious Federation Aeronautique Internationale, Coleman became the only licensed black female pilot.

Returning to the United States in September 1921, Coleman was unable to find a position in commercial aviation. Still determined to succeed, Coleman returned to France in 1921 and specialized in parachuting and stunt flying. She returned to the United States as a "barnstormer," performing in air shows around the country. After capturing the attention of white audiences, Coleman concentrated on performing for the predominantly African-American audiences in the South. Many of her appearances were associated with carnivals, circuses, and fairs on the Theater Owners Booking Association circuit, which included theaters for black patrons that showed documentary film footage of Coleman's achievements between acts. In addition to her great accomplishments in aviation, Coleman lectured in black schools and churches in an attempt to launch an aviation training school for African-Americans. Coleman died in a flying accident on April 30, 1926, ending her dream of establishing the school.

Willa Brown (1906-1992)

Inspired by Bessie Coleman, Willa Brown began flying lessons in 1934, going on to become the first African-American commercial pilot in 1937 and the first African-American female officer of the Civil Air Patrol in 1942. She taught aviation courses in Chicago high schools and later founded a flying school based at Harlem Airport. In 1937, Brown was instrumental in forming the National Airmen's Association of America to promote African-American aviation. She was also cofounder and director of the Coffey School of Aeronautics in 1938, which became the test site for the U.S. Army's experiment in allowing African-Americans into the Army Air Force.[45] The Coffey School taught approximately 200 pilots during the next seven years; several trainees later joined the 99th Pursuit Squadron of Tuskegee Institute. In 1972, Brown became a member of the Women's Advisory Committee on Aviation for the Federal Aviation Administration.

Jacqueline Cochran (?-1980)

Orphaned at birth, Jacqueline Cochran received almost no formal education; she learned to read by reading the sides of railroad boxcars. After starting work at age 8 for 6 cents an hour in a cotton mill, Cochran went on to found a cosmetics company that became her empire. On the advice of her fiancé, Floyd Odlum, she learned to fly, soloing in 2 days and earning her license 18 days later.[46]

Fiercely competitive, Cochran was the first woman to enter the Bendix Race from New York to Los Angeles in 1935, the first year women were allowed to compete. Although she did not win, she acquired a taste for setting records. By 1940, she had set three speed records, won the Harmon Trophy three times, and set a world altitude record.

At the beginning of World War II, Cochran was instrumental in recruiting female pilots for the war effort. Leading by example, she became the first female trans-Atlantic bomber pilot, ferrying planes to the British. Later she was tapped to head the Women's Airforce Service Pilots (WASP), recruiting over 1,000 pilots and directing their activities until WASP was disbanded in 1944. Cochran remained in the Air Force Reserve until retiring in 1970 with the rank of colonel.

Cochran remained active in aviation until heart problems grounded her at age 70. At the time of her death in 1980, she held more speed and altitude records than anyone else in the world. Cochran was also the first woman to break the sound barrier, flying an F-86 Sabre Jet with Chuck Yeager as her chase pilot on May 20, 1953.

Phoebe Fairgrove Omlie (1902-1975)

Phoebe Fairgrove Omlie was born in Des Moines, IA, and, at age 15, moved to St. Paul, MN, with her family. The popularity of air shows at the time featuring stunt pilots, wingwalkers, and parachutists made her decide to become a parachutist. As Omlie got ready for her first jump, she found she could not lift the parachute pack, so the airport manager sent her home.[47] After putting herself through a rigorous weight-training program to build up her strength, Omlie returned to the airport for lessons in parachuting. Before long, she was appearing in air shows nationwide and setting altitude records.

Omlie's association with pilots led to her own training and licensing during the 1920's. She became the first woman licensed as a transport pilot. Omlie was also a charter member of the Ninety-nines when they formed in 1929.

During the presidential campaign of 1932, Franklin D. Roosevelt asked Omlie to fly him from town to town across the country. After his election, Roosevelt invited Omlie to become Special Assistant for Air Intelligence of the National Advisory Committee for Aeronautics (forerunner of NASA). In this role, Omlie helped develop the National Air Marking and Mapping Program as an aid to aerial navigation. Under the program, the names of small towns were placed on the tops of buildings or adjacent hillsides using 3.6-meter (12-foot) letters. Some town names were removed during World War II, but the system is still in use today.

Katherine Stinson (1897-1977)

Although she was born in Texas, Katherine Stinson's original dream was to study music in Europe and return to the United States to become a great piano teacher. Her family was not wealthy, however, so Stinson knew she would have to pay for the trip and lessons herself. A newspaper article claiming that air show pilots could earn up to $1,000 a day was the inspiration for her pursuit of pilot training.[48]

Despite her father's initial resistance to the idea, Stinson took her first airplane ride in January 1912. Her enthusiasm led her to Max Lillie for flying lessons. She flew alone after four hours of lessons and had her pilot's license by July 12th, becoming the fourth licensed female pilot in the United States. Stinson was the first woman to successfully perform a loop-the-loop; she was also the first to add a snap roll to the beginning of the stunt. In 1916, she performed loops at night, attaching flares to her wingtips for dramatic effect. Stinson traveled to China and Japan as part of an aviation promotional tour, the first woman to fly in either country. She also learned how to take care of her airplane and engine by disassembling and assembling them for transport, because she frequently traveled between air shows by train.

Stinson brought the rest of her family into aviation through her own enthusiasm. Her sister, Marjorie, became the youngest female pilot in the country when she received her license. The two sisters and their mother opened the Stinson School of Flying in San Antonio, TX. In addition to teaching many American and Royal Canadian Flying Corps pilots, the Stinsons also taught their brother, Edward, to fly. Edward later became well known for his leadership of the Stinson Aircraft Corporation.

When the United States entered World War I, Stinson volunteered for service but was turned down because of her sex. She then used her flying skills to raise over $2 million for the American Red Cross. In 1918, the Army again rejected her application as a reconnaissance pilot, despite her recent long-distance flying record of 982 kilometers (610 miles) in 9 hours and 10 minutes on December 11, 1917.

After becoming the first woman to win an air mail delivery contract, Stinson went to Europe to become an ambulance driver. Toward the end of the war, she contracted influenza, which later progressed to tuberculosis. She succeeded in overcoming the disease but never flew again.

Louise Thaden (1905-1979)

During the "Golden Age" of aviation, the 1930's, Louise McPhetridge Thaden was considered the second most famous American female pilot. She became the first woman to win several major flying events and awards, setting new records along the way. She believed, "In an age where some men didn't think a woman should drive a horse and buggy, much less drive an automobile, it was a job to prove that females could fly."[49]

Born and raised in Arkansas, Thaden did not learn to fly until after she moved to the San Francisco bay area as a salesperson for the Travel Air Corporation, an aircraft manufacturer. She soloed in 1927, earning certificate number 74, which was signed by Orville Wright. Within two years, Thaden became the fourth woman to hold a transport pilot rating.

She began competing in flying events after her marriage to Herbert Thaden, a former U.S. Army pilot working on the first American all-metal aircraft, in 1928. Thaden set her first world record on December 1, 1928, when she reached an altitude of 6,175 meters (20,260 feet). She followed this with a women's endurance record on March 17, 1929.

Thaden's first win came for the first Women's Air Derby, a transcontinental race from Santa Monica, CA, to the site of the National Air Races in Cleveland, OH, in 1929. Amelia Earhart, Pancho Barnes, and Blanche Noyes all experienced equipment problems, giving Thaden control of the race from Fort Worth to Cleveland.

In 1936, Thaden, with Blanche Noyes as her copilot, won the Bendix Cup, an annual race from New York to Los Angeles, which was opened to women competitors the year before. In doing so, the team also set a new east-to-west record of 14 hours, 54 minutes. This win resulted in Thaden receiving aviation's highest honor, the Clifford Burke Harmon Trophy, in 1936.

Thaden retired from full-time competition in 1938 to devote more time to her family. However, she remained active in flying, achieving the rank of lieutenant colonel in the Civil Air Patrol during World War II. She published her memoirs, High, Wide and Frightened, in 1938.

Linda Finch

On March 17, 1997, the 60th anniversary of Amelia Earhart's departure to circumnavigate the globe, Linda Finch, an accomplished pilot and aviation historian, attempted to recreate and complete Earhart's heroic expedition in 1937. According to Finch, the purpose of her journey was to "pay tribute to a special woman who demonstrated courage and perseverance. She [Earhart] believed that with hard work, people can have their dreams . . ."[50]

Although she was not the first person to attempt Earhart's flight, Finch was the first to do so using the same make and model aircraft, a Lockheed Electra 10E, with only a pilot and navigator at the controls. For the attempt, Finch used an Electra 10E, almost an exact replica of the 1935 aircraft flown by Earhart. In fact, Finch's Electra was powered by a similar pair of Pratt & Whitney 600-horsepower engines. Inside the aircraft, however, Finch had all the advantages of modern aviation, including a Global Positioning System, flight management gear that allowed her to precisely locate her position at the push of a button.

This technology was not available to Earhart 60 years earlier.

Finch left Oakland on March 17, 1997, and returned after 73 days, 23 stops in 19 countries, and 45,865 kilometers (28,500 miles) on May 27, 1997, completing her mission to retrace Amelia Earhart's 1937 route.

WOMEN DURING WORLD WAR II: ROSIE THE RIVETER

During the Great Depression, a time of massive unemployment nationwide, women were expected to "sacrifice their personal ambitions and accept a life of economic inactivity." Married women were perceived to be working for extra "pin" money, not earning wages vital to the household budget. Twenty-six States passed laws prohibiting employment of women.[51] Congress-woman Florence Kahn, a Republican from California, spoke for most of her colleagues when she said that a woman's place should be in the home, rather than in the business world competing with men who had families to support. Secretary of Labor Frances Perkins, the first woman cabinet member, denounced the rich "pin money worker" as a menace to society. The Civil Service then ruled that only one family member would be employed by the agency. Consequently, employers were free to refuse to hire women, especially married women.

When the United States entered World War II on December 8, 1941, attitudes changed dramatically. "Rosie the Riveter" became the symbol for the woman worker in American defense industries during the war. The diversion of men from the labor pool into the military, as well as the increased production levels required to support the war effort, prompted the Federal War Manpower Commission and the Office of War Information to undertake nationwide propaganda campaigns to recruit women into the labor force. Many engineering schools established special training courses for women under the sponsorship of the War Department, the Signal Corps, and other Federal agencies. Aircraft companies inaugurated their own special programs for engineering aides.

Lured by high wages and a sense of patriotic duty, women took the place of men in factories producing aircraft, ordnance, and ships. They became streetcar conductors, taxicab drivers, business managers, commercial airline checkers, aerodynamic engineers, and railroad workers. Women operated machinery, streetcars, buses, cranes, and tractors. They unloaded freight, built dirigibles and gliders, worked in lumber and steel mills, and made munitions. They tested new airplanes, ferried aircraft, and served as flight instructors for the military. Between 1940 and 1945, the number of female workers rose 50 percent, from 12 million to 18 million. In 1940, women constituted 8 percent of total workers employed in the production of durable goods. By 1945, this number increased to 25 percent.[52] At the beginning of 1943, 31 percent of the aviation workforce consisted of women.[53]

Throughout the war years, most women who took jobs entered a world that had always been reserved for men, but they proved that women were able to work as well as men, if not better. In spite of difficult and often dangerous working conditions and discrimination in wages, most women were determined to succeed. Moreover, they were enormously proud of what they accomplished and expressed newfound self-confidence gained from performing work they had never previously had the opportunity to try. By the end of the war, women had found jobs in almost every aspect of industry. As an article in the August 23, 1943, issue of Newsweek reported: "There are practically no jobs, it has been found, that cannot be adapted for women workers."[54] The article also noted that, in 1920, women made up 20.4 percent of the total labor force; by the end of 1943, that number had risen to 30 percent. Furthermore, in some key industries, such as aircraft manufacturing, the number of women employees rose from none to hundreds of thousands.

According to an article entitled "Women At Work," which appeared in the August 1944 issue of National Geographic: "The balance of power rests in women's hands. Literally. Behind the whine of sawmills and roar of blast furnaces, the hammer of arsenals and thunder of machine shops—in shipyards, factories, foundries, slaughterhouses, and laboratories—women are manipulating the machinery of war." The article went on to describe the extraordinary variety of work performed

by women and ended with the following statement: "It's a man's and woman's world [emphasis added]."

On August 14, 1945, World War II officially ended. The men returning from the battlefield forced a demobilization of the women. The Office of War Information asked magazine editors to publish stories about jobs for women in the postwar job market. In contrast to the technical jobs held during the war, traditional "women's" jobs, such as teaching, nursing, and clerical work, were promoted as the best careers for women in postwar America. Government and industry, which had appealed to the patriotism of America's women to get them into the labor force, summarily expected women to leave once the war was over. The door to nontraditional job opportunities that opened for women during the crisis of war closed when the Nation regained peace.

Women had gained new skills and developed independence and social awareness during the war years, however, and could not be entirely dismissed. Although demobilization caused 3 million female workers to leave the labor force by 1946, more women remained as workers than before the war began. Overall female employment stood at 17 million in 1947. By 1948, the number of women in the workforce started to increase again, despite limited job opportunities. In the 1990's, record numbers of women continue to enter the labor force.

In sum, Rosie the Riveter was told she could do anything during the war and that was exactly what she did. To use the words of an article in the August 9, 1943, issue of Life, "they have proved that in time of crisis, no job is too tough for American women."[55]

URBAN DESIGN AND LIVABLE COMMUNITIES

Jane Jacobs (1916-)

Jane Jacobs was born in Scranton, PA, in 1916. After graduating from high school, she worked for the local newspaper as an unpaid assistant to the editor of the women's page. She left Scranton during the middle of the Depression for New York City. Jacobs held various positions in New York and struggled through periods of unemployment. She met her husband, architect Robert Jacobs, while working for the Office of War Information. After 30 years in New York City, Jacobs and her family moved to Toronto in 1968, where she currently resides and writes.

Through her own observations of the dynamics of city life, Jacobs formulated philosophies about the city that are well respected by practicing planners, as well as students of city planning. She does not have professional training in the field of city planning, but her ideas, which are sometimes unorthodox, shed light on the inherent qualities that breathe life into a city.

Over the years, Jacobs has written numerous books. Her writings cover the fields of urban design, urban history, regional economics, and morality of the economy and ethics. Her first published work was entitled The Death and Life of Great American Cities. Published in 1961, the book, which focuses primarily on the economy of cities and regions, is one of the most influential in the history of city planning. Jacobs criticized traditional planning style that hailed open space as the symbol of successful cities and destroyed communities, separated land uses, and rebuilt sterile areas. She argued that planners should seek to protect neighborhoods, mix land uses, and pay attention to design details that will be useful to people and that will bring people together.

According to Jacobs, people who live in big cities should be able to enjoy security on city streets. This security, she argues, will never come just from the activities of a vigilant police force. Instead, an intricate social system is required, which will automatically achieve the desired effect.[56] Security is achieved from "public actors"; from habitual street watchers, such as storekeepers, doormen, and interested neighbors; and from more or less constant use of city streets at different hours. This is possible only if a rich mixture of activities in buildings of varying ages and characters is embedded in the city.

Central to Jacobs' philosophy is the theme that people do not just want to be in an active neighborhood; they want to live there. Young children and elderly people similarly need lively surroundings. Jacobs protests that traditional city planners do not understand these requirements, because they continue to build civic centers, low-density residential areas, and housing projects segregated by income. These developments combine to produce "boring homogeneous cores which generate traffic for limited periods and then lapse afterward into dead or dangerous districts."[57] Moreover, the high rents in the area serve to squeeze out marginal activities, such as the small business that is just getting started, the colorful shops with strange and exotic merchandise, and the little restaurants and bars. These "deviant, bohemian, intellectual or bizarre" things are what Jacobs says lend spice, charm, and vigor to an area. What makes a big city, district, or street rich is diversity, including diversity of people, of activities, of uses, of buildings, of public and private enterprises. Where such diversity exists, vitality, variety, convenience, and interest, as well as safety, will automatically follow.

To brighten neighborhoods and "unslum" slums, Jacobs suggests that cities act contrary to what urban experts have advised. She proposes the following ideas:

1. Attract mixed activities that will generate dynamic cross-use of land.
2. Cut the length of blocks.

3. Mingle buildings of varying sizes, types, and conditions.
4. Encourage dense concentrations of people.

To Jacobs, massive housing projects that are not built with these objectives in mind are dull and unhealthy. In seeking to make similar changes in transit and community planning, the Federal Transit Administration's Livable Communities Initiative clearly reflects Jacobs' call for greater sensitivity to the needs of individual communities in city planning.

CHEMICAL ENGINEERS

Katherine Burr Blodgett (1898-1979)

Armed with her education from Bryn Mawr and a master's degree in physics from the University of Chicago, Katherine Burr Blodgett became the first female scientist hired at General Electric's research lab in Schnectady, NY, in 1917. Initially, she assisted Nobel Prize winner Irving Langmuir in his work with monomolecular coatings, which are oily chemical compounds that cover water, metal, or glass surfaces with a coating one-molecule thick. With the encouragement and influence of Langmuir, Blodgett became the first woman to receive a Ph.D. in physics from the Cavendish Laboratory of Cambridge University in 1926.[58]

Over several years of work, Blodgett developed a practical application for monomolecular coatings when she found a way to cut reflected glare through glass by layering the compounds on the glass. Commonly referred to as "nonreflecting glass," her invention allowed images to pass through glass without distortion or loss of light. Blodgett's work resulted in a patent in 1938 and found immediate application for eyeglasses, periscopes, telescopes, cameras, and microscopes. Since then, the theory has been used in many other ways, including a process that accelerates the de-icing of airplane wings, greatly improving aviation safety.

Stephanie Louise Kwolek (1923-)

Born in New Kensington, PA, Stephanie Kwolek received her B.S. in chemistry from the Carnegie Institute of Technology in 1946. While working for E.I. duPont in Buffalo, she pioneered low-temperature processes for preparing condensation polymers, which are long-chain, petroleum-derived molecules. As she carried out experiments to make stronger and stiffer fibers, Kwolek discovered polymer science-liquid crystalline polymers and the technology for spinning the polymers into fibers.

Kwolek's most famous development was Kevlar, a polymer fiber five times stronger than an equivalent mass of steel. Originally developed as a reinforcement for rubber in radial tires, Kevlar is now used for products as varied as sails, mooring and fiber optic cables, bullet-proof vests, and aviation parts.

Kwolek retired from duPont in 1986 but remains active as a consultant and serves on committees for the National Research Council and the National Academy of Sciences. Her name appears on 17 patents issued between 1961 and 1986. She has received numerous awards for her efforts, including the Howard N. Potts Medal from the Franklin Institute of Philadelphia, 1969; the Chemical Pioneer Award, American Institute of Chemists, 1980; Creative Invention Award, American Chemical Society, 1980; and the Harold DeWitt Smith Memorial Award, American Society of Testing and Materials, 1988.[59] In 1995, Kwolek was inducted into the National Inventors Hall of Fame.

Edith M. Flanigen (1929-)

Earning 102 U.S. patents during her career, Edith Flanigen is one of the most inventive chemists of all time. Born and raised in Buffalo, NY, Flanigen was class president and valedictorian of her graduating class at D'Youville College. In 1952, Flanigen received an M.S. in inorganic-physical chemistry from Syracuse University, before beginning her 42-year career in the research department of Union Carbide. Initially, she specialized in the identification, extraction, and purification of silicone polymers that would then be used in further chemical processes.

In 1956, Flanigen shifted focus to work on the emerging technology of "molecular sieves." These are crystalline structures that contain molecule-sized pores. The compounds, with their tiny pore sizes, can be used to filter and separate a complex mixture into its constituent parts or as catalysts for accelerating chemical reactions. During her career, Flanigen invented or developed over 200 synthetic substances;

"zeolyte Y" is considered the most important for its role in the refinement of petroleum.

Crude oil, or petroleum, is a highly complex substance that varies substantially in quality and chemical content from source to source. To be used as a reliable fuel, crude oil must be broken down into its constituent parts, including gasoline and diesel, through a process called "catalytic cracking." Zeolyte Y works as a catalyst to optimize the breakdown process. Molecular sieves have made gasoline production more efficient, cleaner, and safer worldwide.

Flanigen's sieves have tremendous application beyond the petroleum refining industry; molecular sieves are used in both water purification and environmental cleanup work.

OTHER CONTRIBUTIONS IN SCIENCE AND TECHNOLOGY

Mary Engle Pennington (1872-1952)

Mary Pennington was a bacteriologist who redesigned railroad refrigerator cars to improve food safety around the turn of the century. Fascinated by chemistry after reading one of her father's books, Pennington pursued a science degree at the University of Pennsylvania in Philadelphia. After she completed all her coursework, the board of trustees refused to grant her a degree. In 1895, however, her professors elected to award Pennington an advanced Ph.D. after declaring hers a special case. Later that year, she enrolled in Yale University's biological chemistry program.

When Pennington completed her studies at Yale, she went to work as a bacteriologist focusing on bacteria toxicity levels in diary products. She was hired in 1905 by the U.S. Department of Agriculture's Bureau of Chemistry, where she researched fish and poultry packing and freezing methods. After the Pure Food and Drug Act of 1906, Pennington became the head of the newly created Food Research Laboratory, where she remained until 1919.[60]

This work led Pennington to examine rail transportation of food products. As cities grew, their rail links to agricultural centers became increasingly important. People wanted fresh food to put on their dining tables, but rail technology for food preservation was crude. Produce was typically carried in refrigerator cars called "reefers." The refrigeration system consisted of a set of air vents that allowed cooler outside air to flow through the reefer when the train was underway. The air-flow system was later replaced by ice-filled compartments, but long journeys required the ice to be replaced at intervals along the route, slowing the train's progress and increasing travel time for the food products.

To study the problem more thoroughly, Pennington equipped a railcar with testing equipment. She arranged to have this rolling laboratory included in freight trains, located next to a reefer. She could then test the food being transported under typical railroad conditions, while checking the reefer's temperature and humidity. Pennington's research found that the insulation used in reefers was typically too thin and their method of construction allowed cracks to form in the exterior shell, exposing the insulation to weather effects and letting outside air into the car. Worse, Pennington found that water tended to accumulate in the cars, either through condensation from the humid air or ice melt. This water and humid air became laden with bacteria and contaminated the foodstuffs in the car.

Based on her research, Pennington designed a reefer with added insulation, improved storage racks, better drainage, and a forced-air system that maximized air circulation in the car. The added expense of these improvements caused railroad officials to resist making the changes for several years, but Pennington eventually prevailed.

Helen Blair Bartlett (1901-1969)

After receiving her Ph.D. from Ohio State in 1931, Helen Bartlett went to work for AC Spark Plug, where she stayed until her retirement in 1966. Bartlett used her knowledge of petrology and mineralogy in her studies of how to use alumina ceramics as insulation for spark plugs.[61] A geologist by training, she was unusual in her field, because she held several patents. In his memorial to Bartlett, Karl Schwartzwalder, Director of Research and Development for AC Spark Plug, noted that she was the first woman to achieve a high technical status in General Motors, of which AC was a division.[62] She was also one of the few female members of the American Ceramic Society.[63]

Gertrude Rand (1886-1970)

In 1952, while teaching at Columbia University, Gertrude Rand became the first female fellow of the Illuminating Engineering Society of America, a technical association dealing with the various aspects of illumination. Throughout her career, Rand applied her training in psychology to the effects of illumination on color perception and industrial lighting, pioneering the field of physiological optics with her husband, Clarence E. Ferree, during the 1910's.[64]

From 1928 to 1943, Rand was employed in the Wilmer Ophthalmological Institute of Johns Hopkins University. While there, she and Ferree worked on the lighting system for the Holland Tunnel between New York City and Jersey City, NJ. During the war, the pair developed standards of visual health and acuity for airplane pilots and ship lookouts. They held numerous patents for lighting devices and instruments.

In recognition of her contributions to the body of knowledge about the interaction between illumination and vision, Rand received the Illuminating Engineering Society's Gold Medal in 1963. She also became the first woman to receive the Edgar D. Tillyer Medal of the Optical Society of America in 1959.[65]

Elsie Eaves (1890-1983)

Elsie Eaves was a graduate of the University of Colorado in coal engineering. She joined the Engineering News-Record (ENR) in 1926 and later became manager of ENR's Construction Economics Department.[66] During her tenure in this position, Eaves directed ENR's measurement of "Post War Planning" in the construction industry. The collected data were used by the Committee of Economic Development and the American Society of Civil Engineers (ASCE) to estimate what work could go forward promptly when World War II ended. Eaves then converted the data into the first continuous data base of construction in the planning stages.[67]

Eaves' efforts to develop construction cost indexes and trends and apply them nationwide resulted in several valuable tools for the construction industry, the public sector, and other industry sectors that supply or receive services from the construction industry. Eaves was also instrumental in establishing industry standards cited in legislation and legal proceedings.

Among the other firsts in her career, Eaves became the first woman member of ASCE when she joined in 1927 and the first woman to join the American Association of Cost Engineers in 1957. In recognition of her achievements, Eaves was the first woman to be elected as an honorary member of ASCE in 1979. The American Association of Cost Engineers also awarded her Honorary Life Membership; Eaves was the first woman to receive this honor.

Ivy Parker (1907-)

Dr. Ivy Parker, chemist and research engineer for the petroleum industry, specialized in the causes and prevention of corrosion in pipelines. She began working for Shell in the 1930's, later moving to the Plantation Pipe Line Company of Atlanta, GA. Parker viewed pipelines as systems that needed to be kept in tune; her research encompassed data collection on product quality, corrosion protection, pipeline cleanliness and maintenance, filtration, and storage tank maintenance. In 1944, she became the first editor of Corrosion, the official publication of the National Association of Corrosion Engineers. Parker retired from the position in 1965.

TRAVELING IN SPACE

Women have been involved in space exploration since its inception. Although it is not well known today, in the late 1950's, the National Advisory Committee for Aviation (forerunner of NASA) conducted preliminary screening on women as potential astronauts. Before the program was shut down, 2 women had completed all three stages of the same physical and psychological tests used to select the Mercury astronauts.[68] Geraldine (Jerrie) Cobb was the first woman to report to the Lovelace Clinic, in Albuquerque, NM, for the Phase I testing. Based on her test results, an additional 25 women underwent the first phase of testing, while Cobb was sent to Pensacola to undergo standard Navy pilot testing.

Following public pressure against NASA's intent to use women as astronauts, the agency canceled all further testing in July 1961. Congressional hearings into the decision resulted in NASA's announcement that the program had been canceled, because women could not complete jet pilot training. Such training was closed to women until the 1970's.

Sally Ride (1951-)

Sally Ride was the first American woman to go into outer space. She began her studies in physics at Swarthmore College and finished at Stanford University, earning her B.S. in physics and B.A. in English literature. Ride received her doctorate in physics at Stanford University in 1978.

During her graduate studies, Ride learned that NASA had begun a recruitment effort aimed at encouraging women to apply for scientist-astronaut positions. Ride was selected as an astronaut candidate by NASA in January 1978. In August 1979, she successfully completed a 1-year training and evaluation period. Following training assignments as the on-orbit capsule communicator for missions STS-2 and STS-3, Ride served as a mission specialist on the space craft called STS-7, which launched from Kennedy Space Center in Florida on June 18, 1983. She accompanied Captain Robert L. Crippen (spacecraft commander), Captain Fredrick H. Hauck (pilot), and fellow mission specialists Colonel John M. Fabian and Dr. Norman E. Thagard. This was the second flight for the Orbiter Challenger and the first mission with a five-person flight crew. The social implications of the first American woman's journey in space overshadowed the technical accomplishments of the mission.

In 1987, Ride left NASA for a teaching position at Stanford, partially as a result of her concern about the continuing lack of women scientists and engineers in the workforce. Since then, Ride has written children's books about space exploration. She is currently employed at the California Space Institute, where she is conducting research on the opportunities created by space science and technology.

Other Astronauts

Since Sally Ride's historic mission into space, she has been followed by several other women astronauts. Mae Jemison, for example, became the first African-American woman in space on September 12, 1992. The first American woman to walk in space was Kathryn Sullivan during the 1984 mission 41-G. An oceanographer by training, Sullivan became an astronaut in 1979. She participated in three shuttle missions, 41-G (1984), STS-31 (1990), and STS-45 (1992), spending over 533 hours in space.[69] Another astronaut, Shannon Lucid, now holds the record for the longest period in space for any American (188 days and 4 hours). Her journey to Mir, the Russian space station, began when shuttle mission STS-76 launched on March 22, 1996, and ended with her return aboard STS-79 on September 26, 1996. Before the Mir mission, Lucid had participated as mission specialist on four other shuttle missions.[70] Finally, Lt. Colonel Eileen Marie Collins is the first woman pilot in the space shuttle program. Her first mission as a pilot was STS-63, when Discovery was launched on February 3, 1995.

WOMEN ADMINISTRATORS IN TRANSPORTATION

Many exemplary women have been employed by the Department of Transportation (DOT), the Federal Highway Administration (FHWA), and other Federal, State, and local transportation agencies. The following sections highlight the achievements of the first women to join these organizations.

Beverly Cover

Beverly Cover was sworn into office by Deputy Administrator D. Grant Mickle on April 2, 1962. A native of Cumberland, MD, and the second woman in the long history of the Georgia Institute of Technology to receive a Bachelor of Civil Engineering degree, Cover was the first woman highway engineer to join the Bureau of Public Roads, which later became the FHWA. As highway engineer, she was involved with traffic performance, highway capacity, and driver behavior studies. She resigned in September 1964 to devote more time to her family.

Judith A. Carlson

Judith A. Carlson was hired by the Bureau of Public Roads as a highway engineer after graduating from Michigan Tech with a degree in civil engineering in June 1964. Her duties included reviewing, advising on, and approving State highway activities from the planning stages through completion of construction.

Karen M. Porter

A civil engineering graduate from Merrimack College in North Andover, MA, Karen M. Porter joined the Bureau of Public Roads in September 1964 as a systems analyst. Her responsibilities included working with hydraulic engineers to develop computer programs to design highway culverts, helping bridge engineers develop programs to compute the most economical structures that can be built under given conditions, and assisting planners in using data obtained from household surveys to forecast future traffic volumes and transportation needs.[71]

Mary Anderson

Mary Anderson graduated from Prairie View Agricultural and Mechanical College with a degree in engineering and joined FHWA in January 1970 as a highway engineer. She was the first woman to successfully complete FHWA's 27-month highway engineer training program.

Alinda C. Burke

On August 8, 1980, Alinda C. Burke became the first woman to be sworn in as Deputy Administrator for FHWA. She was formerly a Special Assistant to Secretary of Transportation Neil Goldschmidt. As Deputy Administrator, she assisted Administrator Jon S. Hassell, Jr., in directing the $8 billion Federal-aid highway program.

Elizabeth Dole

Elizabeth Hanford Dole was sworn in as the new secretary of DOT on February 7, 1983. She spent 4 years as Secretary of Transportation, overseeing a departmental budget of $27 billion. She became the first woman to head a branch of the armed forces (the Coast Guard falls under the DOT during times of peace) and she became the seventh woman to serve in the cabinet.

When Secretary Dole joined DOT, she made safety the dominant theme of her administration. She was immediately interested in studying possible ways of saving lives in various forms of transportation. Research on rear-end crashes showed that a brake light in the rear window of an automobile greatly reduced the total number of these crashes. DOT had earlier ruled against

requiring rear-window brake lights for all new vehicles, but Secretary Dole reversed the decision. Dole also oversaw an abundance of safety research, and she began taking action on the issue of passive restraints. She favored the air bag, even though previous administrators had resisted requiring automakers to place passive restraints in new models of automobiles.

The Supreme Court ordered a further investigation on the need for passive restraints. Secretary Dole sought a solution that met both the current and long-term needs of society. Under the DOT plan Dole and her staff devised, all models of automobiles were required to have some type of approved automatic passenger restraints by 1990, unless two-thirds of the Nation's population lived in States with strict safety belt laws. This concept was called Rule 208, and it influenced people to use the safety belts that were already available in their cars. The concept also provided crucial data for rear-end and rollover crashes. The same plans also recommended that car manufacturers produce air bags for the side and front paneling of cars.

Rule 208 was essentially a peacemaker. It ensured that States would have to start passing laws that would make the use of seatbelts mandatory and that, when the automakers improved their technologies, new laws would be passed requiring passive restraints in all new car models. In 1984, only 14 out of 100 people wore their seatbelts regularly, and the States did not have laws requiring seatbelts to be worn. In 1990, almost half of the people in a test group wore their seatbelts.

Dole has received many awards, but the one she values most is the 1989 National Safety Council's Distinguished Service to Safety Award. As one of the few women in a top-level administration job, the former Secretary of Transportation was not only an advocate for public safety, she also aided in the advancement of women within the Department. Since working at DOT, Dole has held other prestigious positions, including Secretary of Labor and President of the American Red Cross.

Carmen Turner (?-1992)

In 1983, Carmen Turner became General Manager of the Washington Metropolitan Area Transit Authority (WMATA) and the first African-American woman to lead a major transit agency. She attended American University and obtained her master's degree in public administration.

In 1970, Turner joined the Urban Mass Transportation Administration in the agency's Office of Civil Rights. She became the Acting Director of Civil Rights for the U.S. DOT in 1976 by special appointment of the Secretary of Transportation. In 1977, former Washington Metro General Manager Theodore Lutz chose Turner as the Metro's first Assistant General Manager for Administration. In 1983, she became the first and only Washington Metro General Manager to be selected from within the organization.

At the beginning of her tenure, Turner successfully handled an injunction that halted construction of the Green Line east of the Waterfront station in the metropolitan Washington area. Federal funds for construction were put on hold until the issue of whether there were enough railcars to meet future needs was addressed. Turner was soon noted for her outstanding leadership in the transit industry, especially because she tackled these problems so soon after her appointment. Under Turner, the Washington Metro earned the transit industry's highest honor, the Outstanding Achievement Award from the American Public Transit Association (APTA), in 1988. APTA also named Turner Transit Manager of the Year the following year. During Turner's tenure as General Manager, Metrorail expanded 40 percent, growing from 68 kilometers (42 miles) of track with 47 stations to 117 kilometers (73 miles) of track with 63 stations, while annual ridership grew to 70 million passengers. The highlight of Turner's Metro career came in 1990, when Congress authorized $1.3 billion to complete the 166-kilometer (103-mile) Metrorail system. Turner's major concerns were completing the Metrorail system, controlling costs of operating the bus and rail systems efficiently, and making public transportation easier for passengers to use.

Under Turner's management, WMATA provided more than 1 million bus and rail transit trips for Washington area residents every weekday. In 1990, Turner's last year as General Manager, she was responsible for a $200 million annual capital construction program for fiscal year 1991, along with a $615 million operating budget, and she managed approximately 9,000 employees.

Turner died on April 9, 1992. She was inducted into APTA's Transit Hall of Fame in October of that same year.

CONCLUSION

Today, Americans travel more than ever before. We walk, bike, drive, and take buses, trains, and planes. Transportation is critical to the economy of the United States. Our transportation systems must be effective and efficient and must strive to be equitable. Not only must we maintain the systems already in place, but we must be willing to take chances and explore new ideas that move our nation forward into the next century.

Women are an essential part of today's labor force, yet women are still underrepresented in the technology areas. There are more than 60 million women in the labor force today, yet women make up only 8 percent of engineers, 18 percent of engineering technicians, and 30 percent of natural scientists.

Now that the automobile is the primary mode of transportation for most Americans, automobile manufacturers must design and build cars that meet the national and state air quality and safety standards and appeal to American drivers. Women hold key positions with automobile manufacturers and continue to be strong advocates for safety in automobile design. Women working as chemical engineers, structural engineers, highway engineers, planners, geographers, and computer analysts all contribute to our mobility today.

The important contributions of women as administrators in the U.S. DOT carry on today. Jane Garvey is head of the Federal Aviation Administration, and Jolene Molitoris is the Administrator of the Federal Railroad Administration; other prominent women in the current administration include: Gloria Jeff, Deputy Administrator at FHWA; Nuria Fernandez, Deputy Administrator at the Federal Transit Authority; Kelley Coyner, Acting Administrator of the Research and Special Programs Administration; and Nancy McFadden, DOT General Counsel.

Women have not always been welcome in the field of transportation. Women have had to make their own opportunities and struggle to realize their career dreams and goals. Now, however, much of that struggle has been reduced, thanks to the early innovators, pioneers, adventurers, engineers, scientists, and inventors. Without the efforts of these women in the past, the future of transportation would be diminished.

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